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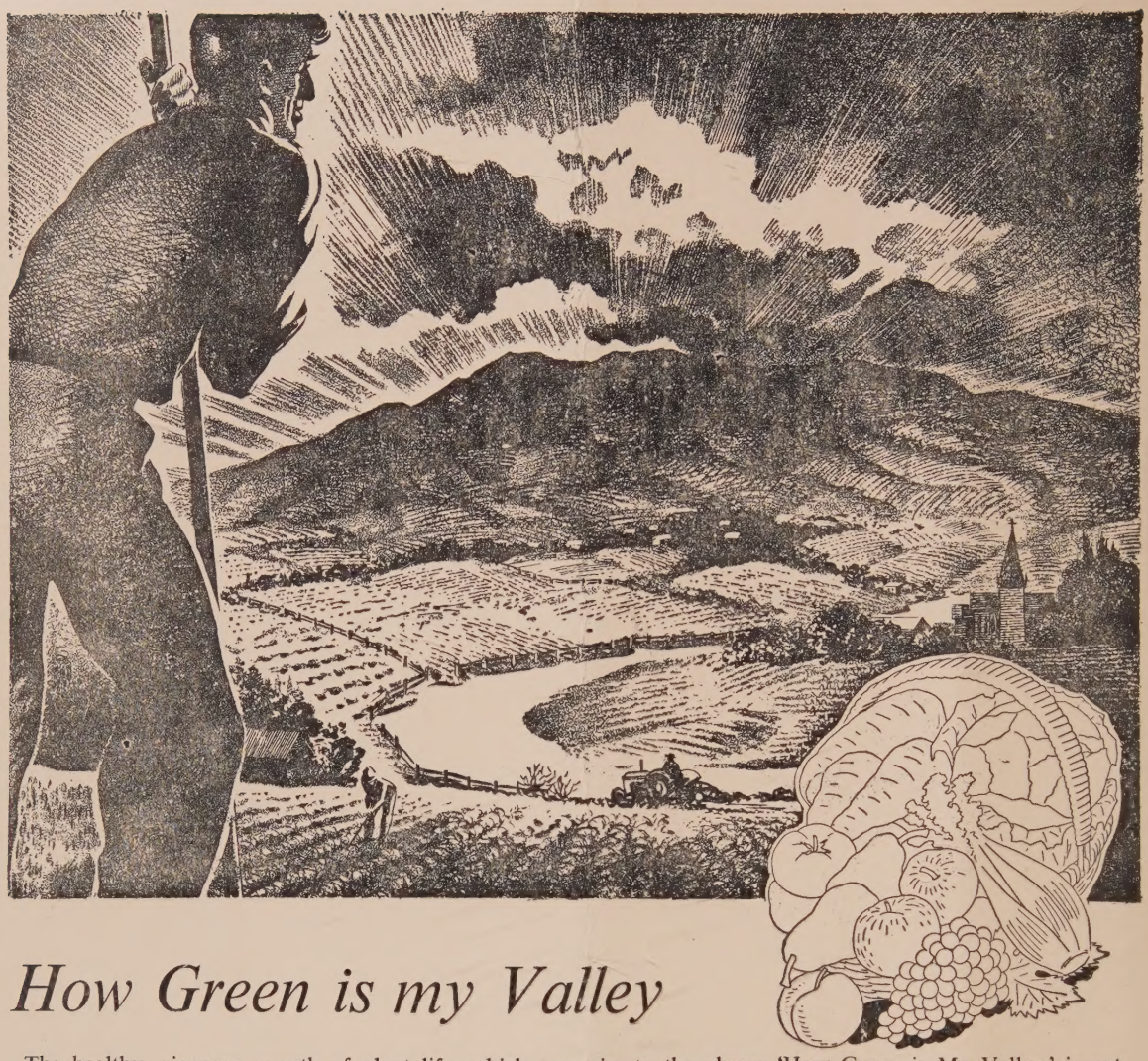

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The Journal of THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

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Guide to Authors

Contributions on agricultural or related topics suitable for publication in the Journal are of three types, namely, "Articles," "Technical Papers" and "Technical Notes".

"Articles" contain general information of a review nature and need not include original experimental work. They should be between 2,000 and 4,000 words in length, although longer or shorter reviews may be necessary with some subjects. Clearly there is no fixed form to be followed when writing articles; however, a flowing style should be used, the treatment should be straightforward and the subject matter should be broken up with short headings at intervals of about 500 words.

"Technical Papers" are intended for the presentation of completed results of original experimental work and in general they can be broken into seven major headings, namely, Summary, Introduction, Method, Result, Discussion, Acknowledgment and References. The introductory section is the most important as the style will determine whether the general reader continues to read on. Here the problem should be stated and the reasons for undertaking the work and its significance should be set out. Above all, the introduction should stimulate the readers' interest. The sections dealing with method and results should be made as brief as possible and only essential facts should be included; there is no need to comment at length on tables or graphs which can be readily interpreted by the reader. The discussion section is important because here the real significance of the results should be stressed and conclusions should be drawn. Papers should be preceded by a short summary suitable for use by abstracting journals and where possible the whole paper should not exceed 2,500 words.

"Technical Notes" are less formal than papers and they need not necessarily report completed work. These notes could include short, interesting items of information such as discussions of interim results of experiments or of observations noted as a sideline to main experiments. Short descriptions of useful techniques or equipment could be included in this section. Technical Notes should be reported briefly and in an interesting style and, generally speaking, should range from 150 to 1,200 words in length.

Manuscripts should be double spaced and they should be submitted in duplicate as part of the delay in refereeing is then avoided.

For more detailed information concerning the preparation and layout of scientific papers, authors are referred to the C.S.I.R.O. publication, "Guide to Authors," and to an article entitled "The Preparation and Editing of Technical Papers," by N. S. Noble, published in the Australian Library Journal, April, 1954. The policy laid down in these publications is also largely followed by the Institute Journal.

ARTICLES

RATOON STUNTING DISEASE OF SUGAR CANE

By C. G. HUGHES

Introduction

Ratoon stunting is at the moment regarded as a serious disease in many of the important cane producing countries of the world. It lacks the obvious symptoms of the common diseases which from time to time have caused losses in cane and on that account may have remained undetected except for the fortuitous chance that a very susceptible variety become infected as it was being rapidly propagated for commercial planting. Even then the presence of a disease may not have been suspected, since on many occasions in the past, varieties have lost vigour without any obvious cause, but in this instance, only part of the stock became infected, and it happened that numerous comparable plantings were made with plants from diseased and healthy sources at an early stage in the propagation.

The disease was discovered in Queensland and work here has established its transmissibility and methods for control and also the fact that somewhat inconspicuous internal symptoms are associated with the stunting. Although the progress of the investigations has been published from time to time, it is only with comparatively recent personal contacts that pathologists overseas have become alive to the importance and implications of the disease.

Historical

The history of ratoon stunting disease started in the early weeks of 1945 when it was noted at Mackay, Central Queensland, that some ratoon fields of the promising new variety Q.28, which had remained inexplicably backward through a dry spring and early summer, failed to respond as expected to the first of the wet season rains. Excellent follow-up rains did not effect any improvement and the fields produced poor and uneven stands. At harvest, yields were often only a quarter of what the farmers had reasonably expected, and investigations into the problem were initiated during that planting season. It was soon found that the yield, particularly in the ratoons, varied more widely from field to field than could be explained on any obvious cultural features, and that the variation depended on the source of plants. Setts from some farms, even some which had themselves produced good crops, gave poor crops when planted elsewhere while setts from other farms gave normal, vigorous ratoons.

Early experimental plantings suffered severely from abnormal seasons and both drought and floods interfered with the interpretation of results; by 1949, however, it was established that the trouble, still at this stage referred to as "Q.28 disease", since it appeared to be confined to that variety, was transmissible. This was of great value in further studies and investigators were helped still further by the discovery in 1952 that the disease which had been thought to have stunting and loss of weight as its only symptom, produced characteristic internal markings in the mature cane. Using these markings for diagnosis ratoon stunting was then

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found present in all Queensland mill areas by the end of 1952. In the same year canes imported from certain overseas countries were found infected in the Bureau quarantine house while undergoing quarantine prior to distribution for testing. The infection in these canes was the first indication that ratoon stunting might be present outside Queensland, a fact amply confirmed by Bureau officers when visiting overseas cane countries during 1953. They found the disease widespread in the cane producing areas of Hawaii, Louisiana, Florida, Colombia, the British West Indies and South Africa. In addition, it appears to be present in Taiwan, Puerto Rico, Mexico and India and specimens from the northern rivers area of New South Wales have confirmed its presence there.

It is of great interest to note that ratoon stunting does not appear to be present in New Guinea, which is one of the world focal points of the genus *Saccharum*. More than one hundred varieties were collected there by Bureau officers in 1951 but examination after introduction into Queensland did not reveal any symptoms in either the noble (*S. officinarum*) canes or in the wild canes of various species imported for breeding purposes.

Symptoms

The chief symptoms are a loss of vigour of the cane resulting in a stunting and poor yield, particularly in the ratoons, a discolouration of the vascular bundles in certain parts of the nodes of the mature stem and an internal discolouration in immature stem tissue.

The stunting or reduction in growth is not very obvious in the plant crop although replicated trials have shown considerable losses in Q.28 in the Mackay district and estimated yields on current trials indicate similar results in other districts with a wide range of varieties. The results for the Q.28 trials are summarized in Table I and it should be mentioned that all differences in both plant and ratoon trials between crops from healthy and diseased planting material are significant at the one per cent. level. In the plant crop the reduction in yield of up to 30 per cent. is not accounted for by a slight depression in germination, but appears to be due to a reduction in number of shoots and/or a reduction in diameter of stalk. The overall length of the cane may or may not differ appreciably between the diseased and healthy plots and, if it were not possible to make close comparisons, the loss in tonnage due to the disease could often easily be overlooked. Diseased plant crops show the effect of dry weather before healthy ones both in an earlier cessation of growth as the soil dries out and in an earlier display of drought symptoms such as wilting during the heat of the day,

TABLE I

Summary of losses in Q.28 due to ratoon stunting disease.
(Tons of cane per acre.)

Trial No.	Planting Material	Plant Crop			Ratoon Crop			Two Crops		
		Yield	Loss	% Loss	Yield	Loss	% Loss	Yield	Loss	% Loss
1	Healthy	28.6			27.6			56.2		
	Diseased	17.9	10.7	37.4	9.6	18.0	65.2	27.5	28.7	51.1
2	Healthy	36.0			20.5			56.5		
	Diseased	27.7	8.3	23.1	7.5	13.0	63.4	35.2	21.3	37.7
3	Healthy	30.2			17.0			47.2		
	Diseased	23.9	6.3	20.9	10.0	7.0	41.2	33.9	13.3	28.2
4	Healthy	40.1			29.6			69.7		
	Diseased	33.1	7.0	17.5	11.4	18.2	61.5	44.5	25.2	36.2
5	Healthy	37.3			30.3			67.6		
	Diseased	33.0	4.3	11.5	10.0	20.3	67.0	43.0	24.6	36.4

Figure 1.
Loss of vigour due to ratoon stunting in Q.28 at Mackay, Central Queensland. Healthy cane of same variety on right.

scorching of the tips and edges of the leaves and premature death of the older leaves. Good growing conditions, especially if the soil moisture is maintained at a satisfactory level for the whole growing period, will mask the effects, a factor which can interfere seriously with the estimation of losses in resistance trials.

In ratoon crops of susceptible varieties under normal farm conditions the stunting is very marked and serious losses in tonnage result. Adequate irrigation will, as in the plant crop, mask the effects to a considerable extent but even in the heavy rainfall areas of North Queensland there are usually sufficient comparatively dry periods to allow the disease to damage ratoons seriously. Apart from the provision of adequate water supplies, there does not appear to be any agricultural practice which will help minimize losses when diseased planting material has been used. Infected ratoons do not usually show any early death of the stools but they come away much more slowly than normal crops. In some instances, crops cut and ratooned several months previously have the appearance of having been cut only a fortnight before and subsequently never make up the leeway. The decrease both in size and number of shoots is obvious and the mature, diseased, ratoon stools have fewer and smaller stalks than the healthy. A marked feature is the "up-and-down" appearance of a diseased block and even where every sett planted is known to be infected this marked variation in size from stool to stool is found. The larger stools do not result from recovery or "escapes" and if used as plants show they are definitely diseased. Actual death of the stools is not a common feature of ratoon stunting although when the winter and spring are very dry, much of the diseased crop may be dead by harvest. Before this stage is reached frequently whole fields are so desiccated that not a single green leaf can be seen but closer examination will reveal that the stalks are still alive.

Figure 2.
Ratoon stunting in the variety Trojan, near Cairns, North Queensland. Healthy cane on right.

Heavy losses from ratoon stunting have been suffered in every mill area in Queensland. Figures for Q.28 at Mackay (Central Queensland) are quoted in Table I but similar results have been seen in both southern and northern areas. In the south, Q.28 has had to be abandoned until new disease-free stocks have been built up and in the north, numerous poor ratoons in the leading variety Trojan, leave no doubt that the disease is seriously affecting crops there (see Figure 2).

Internal discolouration of nodal vascular tissue is a useful diagnostic symptom of ratoon stunting disease even though it varies considerably as between different varieties and many other factors may give rise to a similar effect. The discolouration is usually most conspicuous in nodes of mature cane where it shows in the vascular bundles as they commence their convolutions and branching in the lower part of the node proper after their straight course through the internode. The discoloured bundles may be seen by careful transverse sectioning at the base of the node but the zone showing discolouration is usually saucer shaped across the stalk and the transverse cut will show at any given level only a comparatively few affected vascular bundles. Longitudinal slicing reveals more bundles per cut and is the method usually adopted in field surveys. It must be done with a sharp knife making a smooth surface so that the bundles are actually cut, since the discolouration is due to material clogging the xylem and is more obvious when the vessels are themselves cut. The angle which the vessels make with the cut surface determine the shape of the individual discolourations exposed; if the vascular bundle is sliced lengthwise the discolouration will show as a line, perhaps one-eighth of an inch in length; if it is sliced across only a discoloured dot will appear, and there will be gradations between these extremes.

Some varieties show when diseased only a cheddar cheese, or even lighter, colour, which makes positive diagnosis somewhat difficult without considerable experience. The majority of commercial canes, however, produce a discolouration usually approaching a liver red which is fairly obvious and in marked contrast to the uniform cream or white of the nodes in healthy cane.

The number of bundles affected varies within wide limits from stalk to stalk in the one crop, in crops in different parts of the State and in crops of varying stages of maturity. Certain varieties regularly show a large number of discoloured bundles while others are much more variable. On occasions so few affected bundles are found that a large number of stalks have to be sectioned before a positive diagnosis can be made.

A vascular discolouration, as mentioned above, may be due to factors other than ratoon stunting disease and care should be taken that these influences are elimin-

ated from the stalks sectioned. Certain diseases such as leaf scald (*Bacterium albilineans*) and chlorotic streak (probably due to a virus) cause reddening of vascular bundles and a similar effect may result from hormone weedicide damage, a growth crack in the rind, or an internal necrosis or damage to the stalk by animals or insects. In addition, discoloured bundles near the rind can be caused by oxidation or infection of bundles broken at the leaf scar as the leaf was shed.

That a general discolouration in the nodes of very young, immature shoots is also due to ratoon stunting disease is a recent discovery and it is not yet clear whether this symptom shows over as wide a range of conditions and varieties as do the discolourations in the mature stem. The colour produced in these young nodes is a general light pink visible only immediately on sectioning before oxidation products mask it, but it is quite obvious, particularly when comparisons can be made with healthy tissue. This symptom has been recognised in young stalks, the growing points of which were well below ground level, only six to seven weeks after planting.

Transmission

Primary transmission is per medium of infected setts and, as far as is known, diseased setts will always give rise to diseased plants. It is the most important method of spread and has no doubt been responsible for the widespread nature of the disease in Queensland and also probably for its wide occurrence in other countries. Primarily infected stools show more serious stunting than those which acquire the disease sometime during growth.

There is some evidence that an unknown method of spread does occur in the field under certain conditions, but it is not a very efficient method and numerous instances have been seen where in diseased and healthy plantings made side by side in adjacent rows, or end to end in the same row the healthy plantings have remained apparently disease-free for two or three crops, i.e., for up to four years. In contrast to the slow natural spread is the readiness with which mechanical transmission occurs. Various inoculation tests have shown that sap from stems, leaves and roots is infectious, even at considerable dilutions. While inoculations into leaf and spindle tissue by pricking through a diseased leaf or a drop of infective juice have not as yet been successful, the standing stalks may be infected by injection of diseased juice and the infection of setts through the cut ends is particularly easy. Setts may be infected by dipping the ends into infective juice, by inoculating the ends with a device which forces the juice into the tissue under pressure, or simply by cutting with a knife which has recently been used to cut diseased stalks. The first two methods of inoculation are reliable and are used (particularly the pressure inoculations) for nearly all experimental work, but knife infection is the most important method of spread under commercial conditions.

The ordinary cane knife as used either for cutting setts or for harvesting mature cane is quite efficient but the blades of the cutter-planter are even better and numerous instances have been recorded where a cutter-planter has infected healthy material up to 40 yards along a row after cutting diseased stalks.

There is no evidence that the ratoon stunting will persist in the soil or in pieces of dead stubble ploughed out the previous year and, although inoculations have been attempted into plants other than sugar cane, ratoon stunting does not appear to exist in any other host.

The Causal Agent

The usual isolation methods and histological examinations failed to reveal any obvious causal agent. The amorphous substance plugging the vascular bundles and causing their discolouration failed to yield any organisms to either

isolation or examination techniques. Negative results were obtained with screens examined by the electron microscope and preliminary serological tests using rabbits did not give a positive reaction although there was some indication that an antigen did occur in diseased juice.

These numerous negative results plus the known infectivity of the juice even at dilutions up to one in one thousand or even more, indicate the casual agent is a virus. To date work has been largely concentrated on commercial aspects of the disease and although some attempts have been made to obtain the causal agent in a concentrated form, they have so far been without success. However, an active programme is being undertaken to learn more concerning the virus involved.

Control

Although there are considerable gaps in our knowledge of ratoon stunting, sufficient is already known for firm recommendations to be made for its control in commercial cane plantings. The most important measures consist of the use of disease-free planting material and the prevention of mechanical transmission. The use of the less susceptible varieties may also in certain circumstances help reduce losses.

In some areas all stocks of a particular variety have not yet become infected and by using plants from fields with a known history of successful ratoon production some measure of control may be obtained. This method has been of use with established commercial varieties but even with them it does not ensure complete freedom from the disease, especially with varieties which show little obvious losses from the disease. The method is not applicable to new experimental varieties in process of propagation for commercial distribution since stocks of these are perforce small and a reliable history of ratooning unavailable except for small plots over a short period.

The disease is not transmitted through the true seed of sugar cane so that all seedlings are initially free, and they may be kept so, at least in the early stages, by strict attention to sterilization of knives and avoidance of contamination of the plantings with other diseased canes. A more difficult problem is posed by the varieties, both commercial and prospective commercial, which were propagated before the disease was recognised. Clean plants of these canes can be obtained only by the heat treatment of setts prior to planting either by soaking in hot water or by exposure to hot air.

The hot air treatment involves treatment in an oven—sealed to prevent undue loss of moisture—at 50°C. for 24 hours or at 54°C. for eight hours. This has been tested in Queensland for Q.28 and it is presumed that it would also be successful for other varieties, but it is not regarded as commercially practicable in this State. In Louisania, U.S.A., however, where the cane required for plants is immature and for that reason very sensitive to the hot-water treatment, a huge oven has been mounted on a large semi-trailer and loads of one ton of plants at a time have been successfully treated.

The hot-water treatment has been adopted as standard practice in Queensland and in all areas tanks have been set up in association with the sugar mills for the treatment of comparatively large tonnages of cane. The treatment consists of soaking the setts for two hours in a bath at 50°C. Accurate control of the temperature and time is essential since a drop of only 1°C. will lead to failure to "cure" the disease in approximately ten per cent. of the setts. Some of the tanks installed contain as much as 4,000 gallons and the packing of setts into iron and wire-netting baskets, combined with automatic temperature control, and large capacity circulation pumps, ensures an even heating from sett to sett in every batch treated. It

might be thought that less accurate control would be needed if the temperature were raised but the difficulty there is that the 50°C. for two hours comes close to killing the setts and, indeed, with some varieties even this treatment results in very poor germinations.

Both hot-air and hot-water treatment of setts render them more susceptible to invasion by rotting organisms when planted in the ground, since the heating causes some death of cells at the cut ends and on the rind in the nodal region. The dead tissues appear to provide an ideal breeding ground for soil organisms and the treated setts are rotted much more quickly than normal, in many instances before they can germinate and establish new plants. This rotting can be prevented by dipping the treated setts in an organic mercurial solution such as is now regular practice when planting in areas affected with pineapple disease (*Ceratostomella paradoxa*). Alternatively the mercurial may be incorporated in the hot-water bath although at a reduced strength.

Implications of the Disease

The losses caused by ratoon stunting are in themselves sufficiently serious to warrant ranking the disease as the most important in the sugar-cane industry of the world but in addition, there is evidence that it is an important factor in the "running-out" of varieties. Several cane-producing countries (including Queensland) have been raising cane seedlings for more than half a century and many more have commenced during the last two decades or so, but a common, and disconcerting, feature noted over the last few years has been the loss in producing power of the new hybrid canes a comparatively short while after their propagation. In many instances the seedlings which appear so promising in the first few years of their existence just do not make the grade and so are discarded at a comparatively early stage; in other areas, the new varieties reach widespread commercial plantings before the farmers form the idea that the new promising varieties are already "not as good as they used to be". Investigation shows that the farmers' charges are not unfounded and the general solution is to provide more seedlings, which themselves will succumb in due course. Geneticists and other workers in crops vegetatively propagated have not been able to find any mechanism by which varietal deterioration per medium of the soma could occur, but the absence of a known mechanism did not prevent this widespread and marked loss of vigour in cane still remaining after all known possible influences were removed. Infection with ratoon stunting at some stage in the propagation of a new variety does offer an explanation and, although one would be chary of saying it is the only factor involved, it is at least a very important one. The usual methods of selecting, when juice samples are taken with unsterilized instruments, and handling the new seedlings gave every opportunity of infection with the disease and it was pure chance whether the cane developed the disease in the first two or three years, or whether it reached commercial plantings before becoming seriously infected.

That ratoon stunting is important in varietal deterioration in sugar cane is as yet based only on circumstantial evidence but a large number of trials involving a wide range of commercial canes was planted in this State last year and should within the next two years refute or prove the theory. The statistically sound results from the trials will be coupled with observations on many thousands of acres commercially planted with clean cane. Even if these combined results do show severe losses due to the disease in canes known to have deteriorated, observations will have to extend over several more years to establish whether or not ratoon stunting is the only factor causing the decline of commercial canes when subjected to normal farming practices.

(*Received for publication, August* 1, 1954).

THE LOCUST PROBLEM IN SOUTH-EASTERN AUSTRALIA

By T. W. HOGAN

Those species of grasshoppers which have developed the habit of migrating long distances in dense swarms are termed locusts. The only locust of economic importance in south-eastern Australia is the Australian plague locust, *Chortoicetes terminifera* (Walk.), an indigenous species and a major agricultural pest in the eastern states.

Public attention has been drawn to the importance of locusts by a series of outbreaks during recent years. At the same time there has been increasing concern about the problem because of closer settlement in certain inland areas in which the locust thrives. The prospect of rapid expansion of irrigation in the danger areas, following such developments as the Snowy Mountains Hydro-Electric Scheme, is an additional reason for concern as to future policy.

All this, and the fact that New South Wales spent more than £300,000 on locust control during the outbreaks of 1953 and 1954, has raised the question of whether the present practice of making an organized attack on outbreaks only after they have developed to serious proportions is the best one. Recently, careful consideration was given by representatives of the Commonwealth and the States to the practicability of outbreak suppression measures used successfully against certain species of locusts in Africa. This method is based on the fact that locust outbreaks commence in certain favourable breeding areas known as "outbreak areas." The principle of outbreak suppression is to keep the locust population in these areas at such a low numerical level that swarming and migration into other parts of the potential infestation area does not occur. This approach has not been tried in Australia as yet. It must be realized however, that the locust problem in this country differs in many respects from the African, and also that recent improvements in control enable efficient crop protection. Hence, there is room for doubt about the economic advantages of outbreak suppression here, and sufficient data for a final decision can only be obtained by experiment. A trial to determine the costs of this method has recently been recommended by the Australian Agricultural Council and is to be carried out in one of the major outbreak areas in Australia as soon as conditions are suitable.

To understand why such an approach has not been made before, it is necessary to examine the general characteristics of the problem and the measures in force at the present time.

Characteristics of the Problem

Key (1945) has mapped the outbreak areas of *C. terminifera* (see figure 1). The principal outbreak areas occur in a north-south belt down the centre of New South Wales and southern Queensland. Victoria has no major outbreak areas, but northern Victoria is subject to invasion by migrating swarms from the north and possibly the north-west. Key has studied the ecological characteristics of the outbreak areas and shown that they have certain features in common. Apart from being in a particular climatic zone, they have self-mulching soils free from timber, with compact soil for oviposition sites, and food shelter habitats in close proximity to each other.

These conditions usually occur in comparatively small localities known as *out-*

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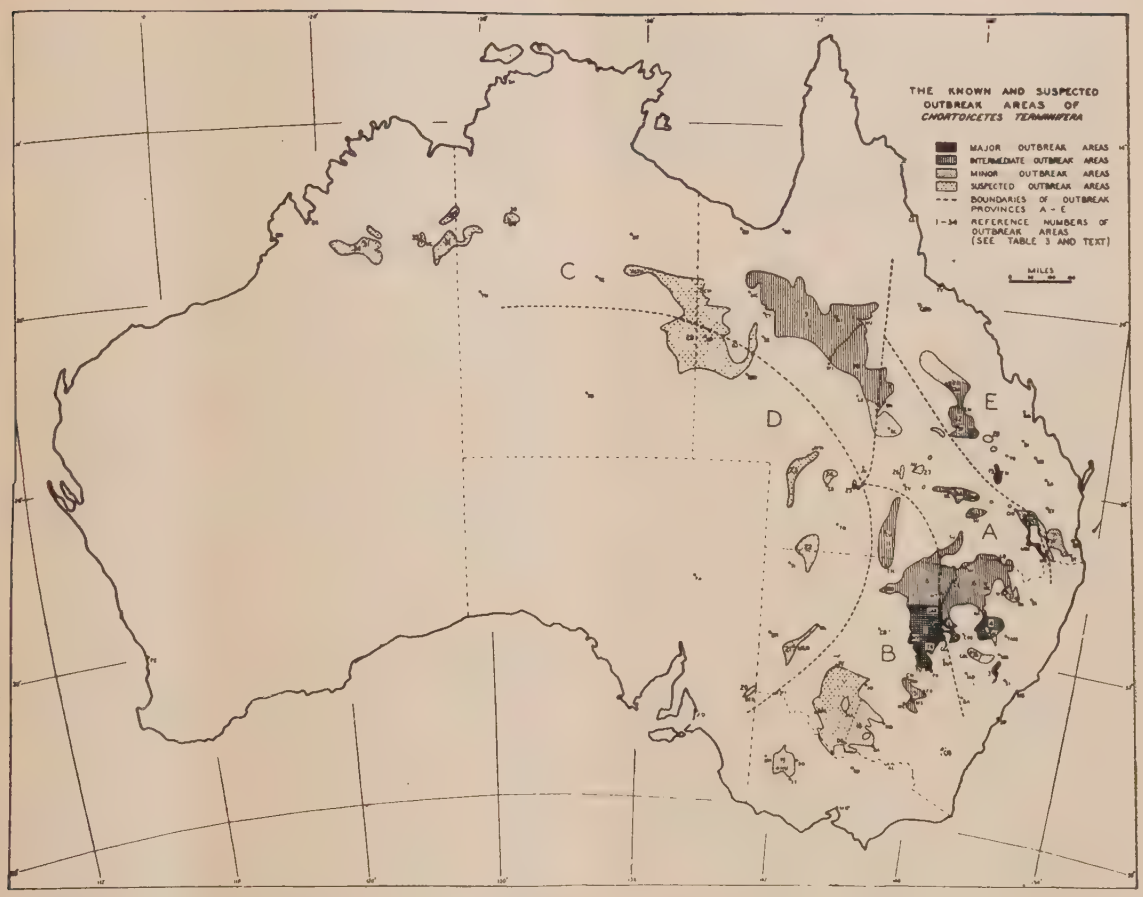

Figure 1.
The known and suspected outbreak areas of the Australian Plague Locust as defined by Key (1945).

break centres. An area where numerous outbreak centres are prevalent is termed an *outbreak area.* These may be some thousands of square miles in extent. Under favourable conditions locust numbers will increase in the outbreak centres, swarms will build up in the outbreak area and migration into the much larger surrounding *invasion area* will take place.

The migration of swarms is associated with complex behavioural and physiological changes known as "phase transformation." This is induced by the crowding of individuals which results from the development of higher population densities. Migratory swarms flying at a considerable height above ground are rarely seen in Australia, but drifting or "rolling" swarms, in which individual locusts are alternatively in the air and on the ground, may travel long distances. Locusts fly at about ten miles per hour and travel hundreds of miles, but 20-40 miles in one day is more usual; and then only when the weather is favourable.

There appears to be no definite periodicity in outbreaks, but since the variability is extreme and the period over which reliable records exist is less than 100 years, it may be too early to determine this yet. Serious outbreaks extending to the limits of the invasion area have occurred only about eight times in the past eighty years prior to 1953, namely, 1870-74, 1889-91, 1907-8, 1917-19, 1923-6 1927-9, 1933-7 (Key 1938).

The principal factor determining the regional and seasonal existence of swarming populations in Australia is rainfall.

Although primarily a grass feeder, any type of green plant may be attacked by the locusts in the absence of graminaceous species. Spectacular damage may be caused by large flying swarms, or nymphal bands invading pasture or crop and causing complete denudation.

The Administration of Control

It is important to bear in mind that with locusts we are dealing with a pest capable of travelling long distances and that ineffective action in one district may nullify the efforts in another district. Control, therefore, is not merely the method used to destroy a swarm, but also the planning and administration of a campaign over a wide territory, the effectiveness of which will be judged by the ability to act at the right time and on a sufficiently wide scale.

The present administration of control is, in the first place, a matter for the individual States. Further localisation of administration occurs, as in New South Wales, where the Pasture Protection Board in each district is responsible for grasshopper control. Usually the graziers pay for treatment by means of a levy proportional to head of stock owned.

Victoria treats the locust problem as a State matter, but government campaigns are not undertaken unless an outbreak shows definite indications of reaching serious proportions.

Knowledge of incipient outbreaks should be greatly improved by the recommendation during 1954, of the Australian Agricultural Council, that a patrol officer be appointed to report swarm developments in outbreak centres. This will enable, and encourage, earlier action than has been usual in the past.

Existing Control Practices

Hoppers

Direct control by insecticides is the only method used in Australia at present. The choice lies between sprays, dusts or poisoned bran bait.

The baiting method has definite limitations. It is of no use against very young hoppers, nor against the flying stage, and variable results are obtained where the vegetation is dense. Since hoppers feed heavily for only a limited time each day, costs are raised by the time spent on carrying out test baiting, and by the delay in waiting for the optimal time for application. Furthermore, there is always a percentage of hoppers which do not feed, for example, those in the process of moulting. Because of these disadvantages, growers often had poor results with baiting in past campaigns and their co-operation lacked enthusiasm.

The recent improvements in spraying methods and materials have been so great that baiting, once the chief method of control, has now been superseded.

The New South Wales Department of Agriculture (Anon., 1954), reported "an amazing change of attitude" on the part of growers following the supply of the new spray materials during the 1953 outbreak. The synthetic organic insecticides, such as aldrin and BHC, are not only very potent, but give a persistent contact residue. Also, they are not very toxic to mammals. The change-over has been further expedited by the availability of low volume spray equipment which has been purchased by many farmers for the application of weedicides.

Against large swarms air-blast machines can be used effectively. These give a quicker coverage than boom sprays and require less travel because of the wider swathes. However, such machines would have to be purchased specially for locust control and lead to high capital expenditure and depreciation.

Aircraft, both large and small, provide a means of rapid spray application, and are of special value in the solution of certain aspects of the problem.

Flying Swarms

Until comparatively recent times, control of flying swarms was considered impracticable. Over the past decade, however, aerial spraying has been developed

to a stage where swarms in flight can be destroyed.

An alternative method of controlling the adult stage is to wait for the occasions on which they are settled on the ground, or are camped for the night, and spray by means of ground equipment. On such occasions, the area occupied by the swarms is much less than when they are in flight. Against this, the time occupied in locating the camped swarms, the amount of travelling involved, and the reduction in the time available for treatment, add considerably to the costs.

Since control of flying swarms has been accepted as a government responsibility, a method or methods applicable to the overall problem is desirable. The following circumstances must be taken into account :—

1. *Large areas.* Locust swarms are often large, and the area to be treated is usually of the order of square miles.

2. *Speed.* Rapid action is needed. Crops can be destroyed in a matter of hours and it is necessary to be able to treat large areas at short notice. Moreover, damage will continue during treatment which, therefore, should be completed in as short a time as possible.

3. *Cost.* The method must keep the costs to a minimum; also it is desirable to avoid high capital investment in machinery, since outbreaks are spasmodic, several years may elapse between them, and the duration of each campaign is short.

The only method to meet all these requirements is aerial spraying with, perhaps, ground machinery as a supplement for the control of small swarms.

Aerial spraying against locusts was investigated during 1945-48 by the Victorian Department of Agriculture with the co-operation of the R.A.A.F. This work was concerned with spray droplet size and the uniformity of distribution of the spray (Hogan, 1951).

In addition, campaigns were conducted in 1946, 1950 and 1953 and on each occasion the technique and organisation were developed further. The final organisation included complete radio communications, and a "spotter" aircraft in addition to the Dakotas.

One Dakota can spray an area of 350 acres in ten minutes, after reaching the swarm. It can maintain a constant spraying rate of 600 acres per hour including loading, and travel to and from the aerodrome. Each aerodrome acts as a base and supply centre for 10,000 square miles of territory and aircraft can be switched from one aerodrome to another without significant loss of time. Very little capital expenditure is required since the aircraft can be hired.

Small aircraft such as an Auster can be employed for survey and for quick transport of the personnel to the area furthest from the aerodrome.

Ground spray machines have not the speed and flexibility associated with aircraft. Supplies have to be transported to each area by truck and the transport of the machinery itself is expensive and time-consuming. Manpower requirements are considerably higher.

The limitation on aerial spraying is the necessity for aerodromes. Fortunately, the critical areas in Australia are reasonably well provided with aerodromes.

The cost of aircraft, although a large item in toto, is not a high proportion of the costs. The total expenditure per acre in the 1953 campaign, for the aircraft supplied by Trans-Australian Airlines, was 2/11 per acre.

Outbreak Suppression

Instead of waiting until a serious outbreak develops and then commencing control operations, a method of outbreak suppression has been employed in Africa against the migratory locust *Locusta migratoria*, the red locust *Nomadacris septemfasciata* and the brown locust *Locusta pardalina*, and has proved successful.

The method originated from the discovery that locust outbreaks commence

in the particular localities termed outbreak areas which were described previously. The basis of the method is to keep the outbreak areas under constant observation and to apply control measures whenever the density of the locust population rises to the swarming level. The exact stage in the outbreak process at which action is taken is a matter of policy and must be decided beforehand. The essential feature of outbreak suppression, however, is that control is exercised in the outbreak areas, and usually at an early stage in the outbreak cycle. Acting in this way it has proved practicable to prevent swarms leaving the outbreak areas, thereby limiting an outbreak to a very small part of the potential infestation area.

Outbreak suppression has the appeal of a "prevention is better than cure" policy, but a number of factors complicate the position in Australia and it cannot be assumed that the method which has proved so successful in Africa is necessarily the best approach to the Australian problem. Certainly it would be advantageous to be free from the threat of severe outbreaks at intervals, but the justification for the introduction of the method would have to be on economic grounds. And to decide whether outbreak suppression has any economic advantage under Australian conditions it will be necessary to have more information on the economics of the problem than is available at the present time.

The two main reasons for an investigation of outbreak suppression under Australian conditions before adopting it on a large scale are :—

1. The Australian locust problem is a much less serious one than those of Africa and the Middle East, where several species are involved and the outbreaks are more prolonged and the potential damage much greater. In South Africa, for example, it is costing about £500,000 per annum to prevent outbreaks of the brown locust (Lea; private communication) and other species in northern Africa cost even more to control. But this expenditure is considered to be much less than the losses that would otherwise occur. Outbreaks of these species in the past were not only extensive and devastating, but were liable to continue for years at a time and were virtually out of control until natural agencies ended them.

In Australia, many outbreaks are prevented, and others quelled, by the occurrence of drought conditions. Since droughts cannot be predicted, outbreak suppression would involve the treatment of some outbreaks which would have been destroyed at a relatively early stage by drought conditions if left alone. Whether it would be more economical to meet the high cost of occasional severe outbreaks, or the constant cost of outbreak suppression, depends upon the mean annual expenditure of (a) an outbreak suppression programme compared with (b) the mean annual expenditure on crop protection, plus the losses to dryland pastures where proper control is not exercised.

There is insufficient information about the economic importance of locust damage to dryland pasture. Since crops can be protected at reasonable cost, the extent of this damage may decide whether outbreak suppression is economically justified.

2. Another important factor has to be considered today which did not apply in the past. This is the very marked improvement in the efficiency of insecticides, their application, and the improved organization of campaigns. These have removed the prospect of outbreaks getting out of control, and enable effective crop protection. The change which has occurred is illustrated by a comparison between the outbreaks which took place in eastern Australia in 1934 and 1953. In the former, a very severe outbreak in New South Wales led to severe crop losses there and to the development of numerous flying swarms which caused further losses in New South Wales and an invasion of Victoria by swarms on such a scale that many even reached southern Victoria. In

1953 an outbreak of similar intensity occurred in New South Wales, but control was effective in the main outbreak areas and no swarms entered Victoria from these areas. In the more westerly regions, on the large outbreak grazing properties control was less effective and aerial spraying was employed to destroy swarms moving south. Thus the problem was changed to a relatively static one in the main outbreak areas, while crop protection by swarm destruction was proved practicable for swarms developed in the outback pasture regions.

In considering future developments, the prospects of still further improvements in technique and organisation must be taken into account.

There is another reason for caution with the outbreak suppression method. When chemical control replaces natural agencies as the chief governing factor of an insect population there is always the possibility that minor, but chronic outbreaks may replace the intermittent, but more severe widespread outbreaks. It has been suggested that this is happening with the brown locust suppression scheme in South Africa.

None of these reasons are sufficient to dismiss outbreak suppression as impracticable in Australia, but if this method of control was introduced into Australia, it may be desirable to modify it to the extent of applying treatment at a rather later stage than is customary in Africa. In this way control by natural agencies will be exploited more fully, while the risk of the outbreak getting out of control has been removed by improved methods of hopper control and by the development of aerial spraying for use against flying swarms. The exact stage at which treatment should be applied is a matter for experiment, and the outbreak suppression trial already agreed to by the States and Commonwealth (see introduction) should provide valuable data on this point, as well as on the costs.

This trial, together with the establishment of a patrol service, appear to be the appropriate steps to take at the present time, and the agreement to finance both of them, represents a major contribution to the solution of the locust problem in Australia.

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SOME ASPECTS OF BACKCROSSING FOR DISEASE RESISTANCE IN CEREALS

By A. T. PUGSLEY

The production of disease resistant varieties of cereal crops has always been a major objective of breeders in Australia and, over the years, many notable contributions have been made. One need scarcely be reminded of the classical investigations of William Farrer which have served as models of procedure for workers throughout the world. In Australia, such methods led to the complete control of flag smut of wheat through the production, by standard pedigree breeding, of resistant varieties in the 1930's.

However, advances in genetics and plant pathology have provided breeders with greatly improved techniques, one of which is "backcrossing". In the hands of competent breeders backcrossing is a remarkably efficient and simple procedure and it is very puzzling to know why it has not been more widely used both here in Australia and in overseas countries.

Several years ago the writer expressed the view that, for wheat, oats and barley, breeding for disease resistance should be based *entirely* on the backcross technique (Pugsley, 1951). Experience since then endorses this view.

Pre-requisites for backcrossing programmes

The establishment of satisfactory inoculation techniques as an aid in effective selection work and the recognition and identification of physiologic races together with the study of their ecology and epidemiology are basic to all disease resistance work and in no sense are they peculiar to backcrossing.

However the precision and certainty which attends backcrossing as a method of breeding demands a clear understanding of the inter-relationships between the physiologic races of the pathogen and the "resistant" genes which are transferred from the donor to the recurrent parent. It is deplorable that we know so little about the genes for resistance to the common rusts and smuts of cereals. For example, it is not sufficient merely to locate a wheat variety reported in the literature as being resistant to, say, stem rust in Kenya or Paraguay and then to confirm its resistance under the local environment. Having done exactly this, one finds from concurrent genetic studies that each of the varieties Kenya 117A and Paraguay 1744 share a common gene for resistance and moreover one which was common to the varieties Eureka and Kenya C.6040 used in previous programmes.

On a world basis there are literally hundreds of varieties and crossbreds listed as potential parents for stem rust work, but without more information as to the gene content of such material the list is nothing more than an embarrassment to the breeder. Some time ago the University of Sydney research group recognised this situation and gave a lead in clarifying the situation with respect to a few varieties. Much more remains to be done by other institutions faced with the the same problem.

The above-mentioned reference to Kenya 117A as possessing the same resistance as Eureka raises another issue of vital importance to breeders. Unpublished work of the author and of Wat-

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son and Athwal have shown that Kenya 117A from the United States is quite distinct from the variety under the same designation from Kenya. On the other hand Kenya Governor and Egypt NA101 are now known to be synonyms. Other instances of similar states of confusion could be given and it would appear that the time has arrived when consideration should be given to the establishment of an internationally recognised centre vested with the responsibility of maintaining "type" material of known genetic constitution closely paralleling that already operative for genetic stocks of maize. With respect to disease resistance the F.A.O. world catalogue of genetic stocks falls far short of modern cereal breeders' requirements and I should imagine has been little used by them in their work. The classification of stem rust resistance on a 0-9 scale without reference to the identity of the physiologic races involved is far too vague for devotees of backcrossing. A much more satisfactory system could be inaugurated if some centre, actively engaged in cereal work, would take upon themselves the task of assembling such material as is described in the literature from time to time. In this way authenticity of material could be guaranteed and, because the scheme would commence in a small way, there would be scope for modification and development as time went on.

One of the most disturbing factors commonly experienced in this type of work has been the changing pattern of pathogenicity which seems to inevitably follow upon the release and widespread cultivation of new resistant varieties. Johnson (1953) has recently reviewed the subject of variation in the cereal rusts and has shown how the extensive growing of rust resistant varieties has influenced both the distribution and prevalence of rust races in North America, Australia and East Africa.

Two methods of approach in countering the new races have been suggested. The first, to accumulate a number of genes for resistance in a single variety, while the second suggestion envisages the production of a number of strains of the one variety, each possessing separate and distinct genes. In the latter case the strains would be released or held in reserve as the occasion warrants.

Future events will decide which of the two procedures is to be preferred, meanwhile production methods in both instances will be based on backcross techniques.

The application of backcrossing in Australia

Since 1942 when the first programmes of work were commenced in Australia a number of disease problems have been subjected to the backcrossing procedure and the following examples serve to illustrate the simple straight forward technique as well as various modifications that have been adopted from time to time.

Wheat-Stem Rust

The transfer of a dominant gene for resistance to races 34 and 126B from the donor parent Gabo to nine Australian varieties was completed in 1948 and a similar tenth project was completed for another variety in 1949 (Pugsley, 1949). It was shown that the task, from the time of sowing the original parental varieties to the bulking of the F_3 of the fourth backcross, could be completed within three years.

Insignia 49 and the "48" varieties Bencubbin 48, Dirk 48, Dundee 48, Javelin 48, Rapier 48, Ridley 48, Scimitar 48 and Seewari 48 are widely grown in South Australia although they are sown on a very restricted acreage elsewhere. They continue to be resistant to stem rust in South Australia and Western Australia but new races, to which Gabo and its derivatives are susceptible, have appeared in the eastern States.

The release of the new resistant backcrossed wheats, so closely resembling in

other respects the old standard strains, represented a radical departure from previous practice in this country. Quite apart altogether from the, as yet, unsolved problem of their nomenclature, various other difficulties were envisaged at the time of their release. For instance, was it likely that the old prototypes might later on masquerade as the new, with the result that farmers might not be certain whether they were growing the old or the new strains? A false sense of security could easily lead to serious losses in subsequent rust epidemics.

In 1953, five years after their release, samples were drawn from twelve South Australian crops and tested for rust reactions with the following results:—

3 samples Insignia 49—all three fully resistant.

3 samples Bencubbin 49—one fully resistant and two partly susceptible.

1 sample Scimitar 48—fully resistant.

2 samples Dirk 48—one fully resistant and one fully susceptible.

3 samples Javelin 48—one fully resistant and two partly susceptible.

The fact that five of the twelve samples were faulty indicates that, in future, some action must be taken to safeguard the identity of resistant backcrossed varieties of wheat when released to farmers. Two avenues of approach suggest themselves. They are (1) the introduction of a seed certification scheme and (2) the incorporation of marker genes as an aid in identification. The practicability of introducing a seed certification scheme is a question for those responsible for seed distribution. The incorporation of marker genes is practised overseas as a means of identifying superior strains of pasture legumes. For wheat, simply inherited characteristics such as the nature of awns, glume colour, colour and hairiness of auricles, suggest themselves and steps have already been taken to use these markers in various projects now being undertaken.

We have seen how recent evidence points to the need for the breeder to base his control of the rusts on more than one source of resistance. At the Agricultural Research Institute, Wagga, present programmes for stem rust are based on resistance from Gabo, Eureka, Celebration, Warigo, Kenya 112A, Kenya 338AC2E2, an Agropyron derivative (P.W. 357-5) from Canada and (*Triticum dicoccoides* x *Aegilops sharonensis*) from U.S.A. They are being used singly and in various combinations.

Wheat-Leaf Rust

Mayo (unpublished data) has recently completed a programme involving the transfer of leaf rust resistance from Kenya C.6041 to a series of South Australian "48" wheats. Kenya C.6041 has a single gene (or perhaps two completely linked genes) for resistance to *Puccinia triticina* race 135AB and to the South Australian races of powdery mildew (*Erysiphe graminis tritici*). It is of interest to note that mildew alone was used as the selective agent during the process of breeding for resistance to both diseases. The derivatives, like the donor parent, are resistant to the more commonly occuring leaf rust race 135AB and also to mildew. These strains have not yet been released for general cultivation.

With a view to providing resistance to a second race of leaf rust (race 138BB) and an additional resistance to race 135AB, Uruguay 1064 from Sydney University was selected as a donor parent. Our own tests as well as those of Watson and Athwal reveal the presence of a single gene in Uruguay for seedling resistance to both 138BB and 135AB. Insignia 49, Dundee 48 and Dirk 51 have been used as recurrent parents and seed stocks of the fourth backcross are now being multiplied for release to farmers.

Wheat Bunt

Although bunt may be effectively controlled with seed dressings prior to sow-

ing this involves a heavy expenditure in materials and labour each year (estimated for Australia at more than £200,000 per annum).

Full details of backcrossing programmes for three varieties, Ridley 48, Javelin 48 and Insignia 49 have recently been published (Pugsley, 1953). It was shown that resistance, in this case a recessive gene "d", could be incorporated in standard varieties within a period of eight years. With existing techniques the selection of resistant plants must be based on the reactions of families rather than on single individuals as was the case with the wheat rusts.

A further programme using a different source of resistance—the American variety Orfed — was completed some years ago, although difficulties associated with the naming of the new strains have held back its official registration and release in Australia. The strain in question is a derivative of Dirk 48 and may conveniently be referred to here as Dirk 51.

Dirk 51 has in turn been used as the recurrent parent, having had leaf rust resistance added to it, so that we now have four strains of Dirk as follows:—

Strain	Disease Reaction		
	Stem rust	Bunt	Leaf rust
Dirk	Sus.	Sus.	Sus.
Dirk 48	Res.	Sus.	Sus.
Dirk 51	Res.	Res.	Sus.
Dirk 54	Res.	Res.	Res.

All four strains have similar agronomic characteristics and should properly be regarded as strains of a variety rather than as distinct varieties. The use of a common base name preserves the relationship between each and is to be preferred to the alternative suggestion of designating each with a separate and distinct varietal name.

Barley Mildew and Covered Smut

From the examples quoted above it is clear that resistance to a number of diseases can be secured by a consecutive series of backcrossing programmes leading to a step by step improvement.

An alternative approach may be adopted whereby two concurrent programmes are carried out separately to be later followed by a merging of the end products of each. This procedure has been used in developing strains of Prior and Research barley resistant to mildew and covered smut. It so happened that Kwan was used as the resistant donor parent in each case.

Repeated backcrossing with Prior resulted in the production of a mildew resistant strain while a second programme resulted in the production of a covered smut resistant strain. The crossing of the two strains then led to the production of the final product resistant to both diseases. A similar plan was also followed with the variety Research.

Conclusions

Before concluding it is perhaps desirable to draw attention to the fact that in no part of the programme has it been necessary to evaluate the agronomic performance of the material being handled. So far the theoretical expectation that qualities of the recurrent parent such as yield and grain quality would be recovered, has been realised. Such being the case it is possible to conduct the work at centres remote from the cereal growing regions. For example, at Adelaide a backcross programme led to improvements being made in the disease resistant qualities of the Californian wheat variety White Federation.

When varieties have been secured which are acceptable to the farmer and the associated processing industries then the most important step can be taken in stabilising an industry on a limited series of varieties. We know this to be of particular importance in the malting in-

dustry where standardisation of raw materials means so much in the manufacturing process. Such stability would be equally important were Australia to introduce a grading system in the wheat industry based on a varietal classification.

When varietal stability has been achieved then backcrossing enables new disease situations to be effectively countered without interfering in any way with the varietal picture or with the raw materials used by the processing industries.

It is hoped that in detailing the results already secured a picture has been presented indicating the value of the backcross technique in cereal breeding.

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BOOK REVIEWS—

REVIEWS OF RESEARCH ON PROBLEMS OF UTILIZATION OF SALINE WATER

UNESCO, ARID ZONE PROGRAMME, IV

(*Unesco publication,* 96 *pp., April,* 1954; *obtainable from Oxford University Press, Melbourne.*)

Unesco has added to its series of publications produced under the Arid Zone Programme a booklet containing three reviews of research on problems of utilization of saline water. Two reviews cover biological aspects while the third sums up the present position on the practicability of salt water purification for irrigation and human consumption.

Two distinguished scientists in the biological field have shared the formidable task of surveying the world's literature on the subject. Mr. Georges Grillot, Head of the Service de la Recherche Agronomique in Morocco has reported on researches in Europe, Africa and the Middle East while Dr. H. E. Hayward, Director of the United States Salinity Laboratory, California, has covered similar ground for Australia, India and the Western Hemisphere. Both authors have adopted slightly different approaches and emphases in their reviews which enhance the value of the publication by widening its scope.

Plant physiology and its relation to salt tolerance, specificity in salt tolerance, osmotic and soil moisture effects and toxicity of specific ions are the principal subjects first outlined. The practical problems in the use of saline water are then discussed with regard to the effect on vegetation and soil. Finally, the broad conditions governing the use of such water are summarised.

There are also sections on the evolution of saline and alkali soils and their classification and Dr. Hayward has contributed a valuable and informative summary on Australian conditions.

One is impressed, in a world-wide analysis of this kind, by the local character of many of the salt problems. It seems, to take but one example, that the surest safeguard in a quality of water appraised is a long-term local experiment with the crop, soil and climate under consideration.

Dr. E. D. Howe, Associate Dean of the Faculty of Engineering University of California, has confined his discussion on salt water purification to those methods which have general applicability and use customary engineering practices. He has determined the cost ranges (U.S.A.) for installation and operation for both domestic and irrigation supplies if they are to compete with natural water supply development. While these costs are not directly applicable to Australia it is obvious that much remains to be accomplished before large-scale conversion of salt water becomes an economic proposition. The U.S.A. has recognized the growing importance of this field of research by enacting legislation which will provide assistance to research likely to produce results of value.

A. WEBSTER.

CHEMICAL CHANGES IN HOT SULPHITE SULTANA DIPPING SOLUTIONS

By A. R. CLARKE and E. M. ROSSITER

Summary

Laboratory experiments have been carried out to determine the fate of the constituents of a hot sulphite sultana dipping solution when such a solution is maintained at 190°F. and mildly aerated. The procedure adopted consists in sampling the solution at intervals and immediately separating each sample into two portions with n-butanol. Analysis of these portions shows that the principal reactions occurring in the solution are carbonation, saponification and oxidation, and the course of each of these has been investigated. Oxidation of sulphite has been shown to be inhibited by the presence of grape juice in the solution. Analyses have also been carried out on samples obtained in a field test and the results correlated as far as possible with those obtained in the laboratory experiments.

Introduction

The drying of sultanas in the Murray Valley irrigation areas is principally carried out on racks under natural conditions. In order to accelerate the drying process it is standard practice to dip the fruit in a solution of alkali containing emulsified fatty oils or esters.

In the mid-Murray areas where natural drying conditions are marginal, a more severe dipping process is employed which involves the heating of the dipping solution to near boiling. In its original form this process tended to produce fruit of an inferior dark colour when compared with the cold dipped sultanas from areas with more favourable climatic conditions. In recent years the areas using the hot dipping process have been rapidly adopting a modified solution incorporating 2% of sodium sulphite. This modification, which was developed by the C.S.I.R.O. Research Station, Merbein, prevents the deterioration in colour previously experienced and also gives protection from damage by micro-organisms if damp conditions are experienced during drying.

The chemically reactive nature of the constituents of the sulphite dipping bath, i.e., sulphite, alkali and oil under field conditions, suggested a need for study of the course which possible chemical reactions would follow. Because of the difficulty of maintaining standard conditions in field dipping operations, the present study was concerned primarily with observations made under controlled laboratory conditions. These have been correlated as far as possible with analytical data obtained from field dipping solutions.

Experimental

The following solutions were prepared in the laboratory.

No. 1: sodium sulphite—potassium hydroxide—dipping oil—water;

No. 2: sodium sulphite—dipping oil—water;

No. 3: potassium hydroxide—dipping oil—water;

No. 4: sodium sulphite—potassium hydroxide — dipping oil — sultana juice—water;

No. 5: sodium sulphite—water;

No. 6: sodium sulphite—sultana juice —water.

The proportions of the active constituents used were: dipping oil 0.4%, potassium hydroxide 1.0%, sodium sulphite 2.0%.

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The dipping oil used was a commercial product consisting basically of sulphated and unsulphated fatty esters*. In the solutions with which grape juice was mixed, it was present to the extent of 1% by volume and the volume of water was correspondingly diminished. With the exception of the potassium hydroxide, the concentrations of the various constituents are those normally recommended for a hot sulphite dip. The concentration of potassium hydroxide, while higher than previously considered normal, corresponds with that found necessary in the field during the 1954 season to ensure adequate cracking of the berries.

In each case the solution was maintained at 190°F. and agitated continuously by a stirrer to ensure homogeneity and provide mild aeration. Samples were taken from the solution at intervals, compensation for evaporation being made by addition of water as required. In this way, with an initial volume of some two litres of solution, the only losses in volume were those due to the removal of the samples themselves. No additions of any of the active constituents were made during the course of an experiment.

Each sample, on being removed from the solution, was at once extracted with n-butanol. The resulting aqueous and butanol portions were treated in the following way.

(a) *Aqueous portion*: Aliquots were titrated separately with standard acid and with standard iodine—thiosulphate to determine their alkali and sulphite contents.

(b) *Butanol portion*: The alkali bound as soap was determined by titration with standard acid.

As expected on the basis of analyses carried out on the titratable constituents of the grape juice used, its inclusion to the extent of up to 1% by volume in a dipping solution caused no significant change in the initial titrations of either of the portions resulting from the butanol separation. The juice contained no significant quantity of material titratable by iodine.

*Mobil Fruit Dipping Oil Special.

Discussion

When a sulphite dipping solution is heated, three principal reactions appear to be involved.

(1) saponification of dipping oil by the potassium hydroxide;

(2) removal of potassium hydroxide due mainly to conversion to potassium carbonate and to a much lesser extent to its consumption in saponification of constituents of the dipping oil;

(3) oxidation of sodium sulphite to sodium sulphate except when grape juice is present.

(1) *Saponification*

The progressive saponification of the dipping oil may be determined from the titration of the butanol layer from time to time provided that the saponification value of the oil has been previously determined. The dipping oil contains both acidic and neutral saponifiable constituents, the former of which react with potassium hydroxide immediately. The latter which predominate and are the most important constituents of the dipping oil in relation to fruit drying, are gradually saponified as the solution is heated. It was the rate of this reaction which it was desired to study. The course of this saponification is illustrated in Figure 1; the results are those obtained in the case of solution No. 3, containing potassium hydroxide, dipping oil and water, although similar results were obtained in each case.

Conditions in the field are rather different because the volume of a dipping solution varies continuously due to evaporation and also to removal of liquid on the berries and the buckets used to dip them. To compensate for these losses, additions are made at frequent intervals from a stock tank containing dipping oil and sodium sulphite in aqueous solution. Potassium hydroxide is commonly added

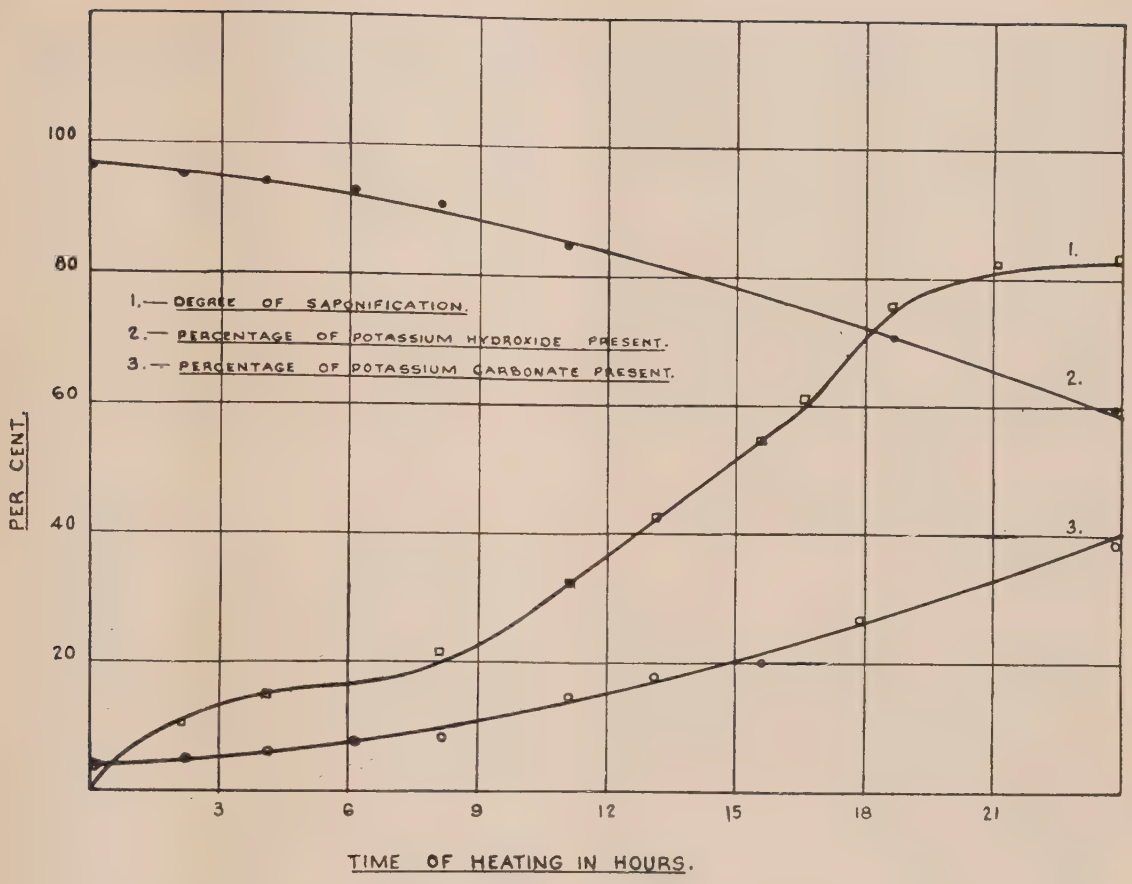

Figure 1.

Proportions of potassium hydroxide and potassium carbonate present, and degree of saponification in a fruit dipping solution heated at 190°F.

separately in quantities sufficient to maintain satisfactory cracking of the skins of the berries. These additions result in the constant replenishment of the dipping solution with unsaponified dipping oil. Consequently at the end of a day's operations the proportion of unsaponified material remaining might be expected to be very much greater than in the case of these laboratory experiments, and this is in fact borne out by the results obtained in the analysis of field samples. In the particular field test during which the samples were taken, saponification of dipping oil was almost completely balanced by additions of stock solution.

(2) *Carbonation*

Analyses carried out on the aqueous layer indicate that gradual carbonation of the alkali occurs due to absorption of atmospheric carbon dioxide and this is accelerated by agitation of the solution. In Figure 1 the relative concentrations of potassium hydroxide and potassium carbonate present after varying periods of heating are shown. Once again, the results are those obtained in the investigation of solution No. 3.

While the diminution in the proportion of potassium hydroxide is readily apparent in laboratory solutions, in field samples a gradual increase was observed.

This indicates that concentration of the solution by evaporation outweighed conversion of the hydroxide to carbonate. It is probable that exposure of the dipping bath to carbon dioxide is less severe under field conditions than under those used in the laboratory experiments.

(3) *Oxidation*

Interesting information resulted from studying the sulphite concentration of the aqueous layer. Sodium sulphite is normally rapidly oxidised on aerating a heated solution and in solutions No. 1 and No. 2 a progressive oxidation was manifest. For example, in solution No. 1 the sulphite was oxidised to the extent of 30% after 10 hours' heating, and 70% after 20 hours.

However, in solution No. 4, in which 1% of juice from freshly crushed grapes was added to a dipping solution prepared in the normal manner, the oxidation of the sulphite was completely inhibited, at least over a period of 21 hours' heating, and in fact for the first 8 hours the apparent sulphite concentration even showed a slight tendency to increase, although the explanation of this is not clear. Table I below indicates the variation in sulphite concentration with time, based on the percentage of unchanged sulphite present in the aqueous layer after various periods of heating.

TABLE I.

Sulphite concentration in dipping solution to which 1% of grape juice has been added.

Time of heating (hours)	Percentage of sulphite present.
0	100.0
2	103.9
$5\frac{1}{2}$	109.2
9	100.0
11	100.6
14	99.4
$16\frac{1}{2}$	95.4
21	100.0

In view of this apparent inhibition of sulphite oxidation in the presence of grape juice, a solution was prepared containing 98% water and 2% sodium sulphite, approximating to their relative proportions in a dipping solution. This solution was divided into two equal portions, to one of which was added 1% by volume of grape juice. The two beakers were maintained as usual at 190°F.; each was stirred equally from time to time with a glass rod. The percentages of unchanged sulphite remaining in each case after heating for a period are given in Table II. Once again, an initial increase in the sulphite concentration seems to occur in the presence of grape juice.

TABLE II.

Sulphite concentration in heated aqueous solutions of sodium sulphite with and without the addition of grape juice.

Time of heating (hours	Grape juice absent. Percentage of original sulphite remaining.	Grape juice present. Percentage of original sulphite remaining.
$1\frac{1}{2}$	96.1	111.0
3	87.9	110.6
6	69.2	109.6
7	63.1	
Heated 15 hours and left standing 1 week	0	108.2 93.3

The inhibiting effect of the grape juice on the oxidation of the sulphite is clear.

It has been stated (Mellor, 1930) that the presence of small quantities of organic compounds — mannitol, alcohol, glycerol, aldehydes, ketones and ethers— decreases the rate of oxidation of sodium sulphite in aqueous solution. A similar effect is said to occur with nitrogeneous substances and alkaloids, and the oxidation is also retarded in sucrose solution. Evidently one at least of the constituents of grape juice functions similarly.

While solutions investigated have contained 1% of grape juice, it is believed that the same effect occurs with quantities considerably smaller than this. In the field there is a progressive accumulation of grape juice in the bath due to mechanical damage of the fruit and its cracking. Samples taken in the field during the course of an actual dipping operation exhibited retarded oxidation, even after only 70 buckets had been dipped. The sulphite still remained unoxidised in samples kept for six months prior to analysis.

In view of the difficulties associated with the interpretation of results obtained in field tests, the most reliable conclusions as to the fate of the dipping oil under field conditions would appear to be those based on the laboratory experiments. Further investigations could, however, well be carried out in regard to the carbonation and saponification occurring in field samples, preferably with experiments designed to eliminate difficulties arising from concentration changes.

Acknowledgment

The authors wish to acknowledge the co-operation of the Nyah-Woorinen Enquiry Committee in providing facilities for field tests at its Research Farm 38H, Woorinen.

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THE EFFECT OF DROUGHT AND TYPE OF BIRTH ON BODY WEIGHTS OF MERINO SHEEP MEASURED AT DIFFERENT AGES

By G. C. TANEJA

Summary

The results indicate that the 5, 11 and 17 months body weights of the Merino lambs born early in spring are greater than those born late in spring; while those born early or late in autumn had nearly the same body weights. Seasonal factors and lack of adequate nutrition due to drought have been suggested as possible explanations.

Correlations between 5 and 11 months, 5 and 17 months, and 11 and 17 months body weights were calculated to be 0.630, 0.644, 0.676 respectively. Multiple correlation between the three body weights was 0.732. Weight at one age is, therefore, a good indication of that at any other age; and that some additional information is obtained by using both 5 and 11 months observations to predict body weights at 17 months.

Statistical analysis of data for variation in body weights due to birth-type suggests that there is a significant difference of about 5 lb. between singles and twins at 5 months of age. But there is a difference of only 2 lb. (non-significant) between singles and twins at 17 months as well as at 11 months.

Introduction

As the Merino is primarily a wool-producing sheep, the study of its mutton qualities has tended to receive little attention. However, if artificial fibres ever displace wool, greater consideration will have to be given to mutton aspects. Among such aspects, body weight is clearly important. And even under present conditions body weight is important in relation to the return to the producer from animals disposed of for slaughter.

This paper is intended as an analysis of the effect of drought and type of birth on body weight. Correlations between body weights at different ages are presented to gain information on whether or not weighing at different ages is important.

Materials

Data on body weights of 284 ewe lambs born in spring 1951 (group "A") and 269 born in autumn 1952 (group "W") were collected from the Trangie Agricultural Experiment Station, New South Wales. The flock of Merino sheep from which these animals were drawn has already been described (Taneja 1955).

The lambs in group "A" suffered from a drought for 6-7 weeks in the pre-weaning period and a further 6-8 weeks in the post-weaning period. These were given drought feed. (Taneja 1955.)

In the spring lambing group (A) 58% of the ewes lambed twins, whereas this figure for the autumn group (W) was 19%.

Method

(i) *Effect of Drought*

Data on body weights of lambs in each group were sorted into sub-groups according to the week in which the lambs were born. For group "A" the exact dates of birth were not available but the approximate order in which the lambs were born could be determined from the ear tag number. Since the lambs were mothered within a few days of birth, the order of birth was approximately the same as the order of identification number. In group W, however, the exact dates of mothering were available. The mean body weights were calculated and the values are shown in Table I.

(ii) *Correlation between Body Weights at Different Ages*

The correlation coefficients between 5 and 11 months, 11 and 17 months, and 17 and 5 months body weights were calculated on 553 lambs (284 from group A

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and 269 from group W, Taneja, 1955) for which body weights were available for all the three ages. The multiple correlation between weights at these ages was then calculated. The statistical procedure used was that described by Snedecor (1946).

(iii) *Effect of Birth-type*

In order to estimate the effect of birth-type (single or twin) 13 sire groups from Group A which had a comparatively larger number of twins and singles were tabulated separately. A set of simultaneous equations was solved to estimate a correction factor for each variable.

The following is the linear mathematical model assumed for estimation of constants:

$$Y_{ijk} = \mu + s_i + b_j + e_{ijk}$$

where Y_{ijk} is the observation for the variable Y, on the kth lamb of the jth birth-type in the ith sire group; μ is the mean of the population. The e_{ijk} are random errors associated with each observation and are assumed to be normally and independently distributed around zero mean with variance $\sigma^2 e$.

The statistical significance of these differences was tested by the method of analysis of variance described by Kempthorne (1950).

Results and Discussion

(i) *The Effect of Drought*

The results of Table I indicate that in group "W" the body weights of lambs born during different weeks in the same lambing period were the same at any age at which weighings were made, up to 17 months. For example, the lambs born in the first week of the lambing period weighed 56.8, 76.7 and 85.4 lb. at 5, 11 and 17 months respectively; while those born in the 5th week weighed 55.4, 76.0 and 86.6 lb. at those same ages. During the 6th week of lambing the body weights of lambs weighed at 5, 11 and 17 months were found to be about 2-4 lb. less but the number of lambs for which the averages have been calculated is very small. On the other hand, in group A, when the

TABLE I

Body weight of lambs at different stages of life born in different weeks during the same lambing period*

Seasonal Group.	Number of weeks in which the lambs were born.	Number of lambs.	Body wt. at 5 mths. lb.	Body wt. at 11 mths. lb.	Body wt. at 17 mths. lb.
"A" (Spring)	1st	44	46.0	78.9	95.5
	2nd	48	44.5	79.3	93.8
	3rd	43	42.0	76.5	93.4
	4th	39	41.1	74.6	92.2
	5th	24	41.0	72.5	91.0
	6th	30	38.2	71.7	90.0
	Average:	228	42.1	75.6	92.7
"W" (Autumn)	1st	55	56.8	76.7	85.4
	2nd	36	57.9	77.9	86.7
	3rd	57	56.6	77.8	86.8
	4th	35	55.7	76.0	85.8
	5th	23	55.4	76.0	86.6
	6th	8	51.9	74.6	83.6
	Average:	214	55.7	76.5	85.8

*Lambs born after the sixth week were not included as their number was very small.

lambs were measured at 5, 11 and 17 months of age, it was found that those born early during the lambing period weighed about 6-7 lb. more at 5, 11 and 17 months than those born later. The reason suggested for this is that group A had unfavourable pasture conditions for 6-7 weeks in the pre-weaning period and for a further 6-8 weeks in the post-weaning period (Taneja 1955), and so the lambs which were born late in that lambing period would suffer a greater set-back than those born early. This finding suggests that lack of adequate nutrition in the period immediately following birth is a greater set-back to the lamb than a similar period of deficiency some weeks later. However, it is appreciated that some seasonal factor associated with early spring birth could have favoured the early lambs of group A (Hammond, Jr., 1944). Disregarding this last possibility, it would appear that in addition to other steps to be taken to meet the drought conditions, provision of the best available nutrition for lambs in their first weeks of life is desirable.

Comparing the average body weights of spring and autumn lambing, it is observed that the 5 month body weight in group A (spring lambing) is about 14 lb. less than that of group "W" (autumn lambing). This is probably due to drought in addition to seasonal variation since Hammond, Jr. (1944) found that the growth in the first two months following birth was greatest in the lambs born in spring; in the fourth to sixth month it was greatest in those born in late autumn and early winter; and least in those born in summer. The 11 months body weights of group "A" are only about 1 lb. less than those of group "W" although the sheep in group "W" were carrying 6-7 lb. of wool at this stage while those in group "A" were freshly shorn. This is probably because after the drought when the lambs were grazed on the green pasture (spring season), they started putting on weight rapidly. Similarly the heavier 17 months body weight of group "A" are due to the fact that the sheep in this group were carrying 6-7 lb. of wool while those in group "W" were freshly shorn.

(ii) *Correlations Between Various Body Weights at Different Ages.*

The following correlations were calculated between various body weights:

$$r_{5 \cdot 11} = 0.630$$
$$r_{5 \cdot 17} = 0.644$$
$$r_{11 \cdot 17} = 0.676$$

where $r_{5 \cdot 11}$ means a correlation between 5 and 11 months body weights and so on.

These results indicate clearly that weight at one age is a good indication of that at any other age. The multiple correlation coefficient between weights at the three ages was R = 0.732 indicating that some additional information was obtained by using both 5 and 11 months observations to predict body weight of 17 months.

(iii) *Effect of Birth-Type*

Differences due to birth-type for 5, 11 and 17 months body weight are presented in Table II.

TABLE II.

Differences due to birth-type for 5, 11 *and* 17 *months body weights of Merinos.*

Age at weighing	Difference between single and twin. lb.	"F" values.
5 months	4.90	6.175 S
11 months	2.30	3.230 NS
17 months	2.00	2.100 NS

S = Significant at 5% level.
NS = Non-significant.
F5% = 3.92.

Only the differences for 5 months body weight were found to be significant (at the 5% level) while those for 11 and 17 months were not significant. The F values and the differences decreased with increasing age.

Hazel and Terrill (1945a) found significant differences between the weaning weights of singles and twins but these differences were found to be non-significant in the yearling stage (Hazell and Terrill, 1946b).

Since the differences in body weights due to birth-type decrease with age, being largest at 5 months and smallest at 17 months, it is suggested that both post-natal and pre-natal conditions are important causes of variation. The relative importance of pre-natal and post-natal environmental effects, as causes of differences between singles and twins, can be gauged by a study of the relative growth rate of singles, twins and twins reared as singles. Thus Hammond (1932) found that up to 4 months of age the weights of twins reared as singles, although lower than those of singles, remained well above those of twins reared as twins. Similarly Hazel and Terrill (1945a) found that the differences between singles and twins reared as singles were significant at weaning. At the yearling stage, however, these same workers showed that although singles were significantly heavier than twins reared as twins (singles minus twins = 6 lb.), the differences between singles, and twins reared as singles (singles minus twins reared as singles = 0.5 lb.) were found to be non-significant. (Hazel and Terrill 1946b). The difference that is apparent in body weights of singles and twins reared as singles at weaning virtually disappears in yearlings. From this, it is concluded that the pre-weaning conditions are more important than the post-weaning conditions in causing variation in body weight due to birth-type.

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TECHNICAL NOTES

BROWN ROT OF STONE FRUITS

II. DIFFERENCES IN INCIDENCE IN THE PEACH VARIETY, LEVIS CLING, ON DIFFERENT SOIL TYPES

From brief references by Rudolph (1925), Harrison (1928), and Roberts and Dunegan (1932) to brown rot in individual orchards it may be inferred that differences in incidence of the disease between orchards occur not only in Australia but in the United States. Such occurrences are either unexplained or ascribed to relative efficiency of spraying, pruning, and other means of control.

In previous notes the writer (1949, 1950, 1951) concluded that the causal environmental factor responsible for differences in incidence of the disease in adjacent trees in Canberra was not the weather and it was suggested that destructiveness was probably influenced by soil and soil moisture conditions in the immediate environment of the tree. Conditions in commercial orchards in the 1954 season afforded an opportunity for more extensive and precise observations than could be made in Canberra home orchards in which the earlier work was done.

In 1954 five inches of rain fell in the Shepparton district and seven inches fell in the Cobram district during the first few days of the harvesting period of the variety Levis Cling. Water accumulated in parts of several orchards and did not disappear from some of them until five to six days after the rains. The greater part of, and sometimes all, the crop in orchards on deep surface phases of sandy loams, drifts and depressions was destroyed by brown rot, whereas on loams the loss was almost invariably negligible.

Surveys were made in three orchards. The first and second were in the Shepparton district and the third near Cobram. The plantings were in rectangular blocks, in which cultural methods were necessarily uniform. Brown rot was severe only in clearly defined areas and was practically absent from other areas in each planting.

Orchard 1.—Four rows of trees were on Orrvale loam, the remaining 18 rows were on a contiguous deep surface phase of East Shepparton sandy loam (Skene and Freedman, 1944). Differences in the stage of development of fruit on the two soil types were no greater than within each soil type. The stage of maturity of fruit, therefore, did not exercise a differential influence on the incidence of disease.

The number of brown-rotted fruit within seven feet of the ground was counted, counting being so restricted, because such fruit, being within reach, could be removed as counted. The mean number of brown-rotted fruit on 35 trees on Orrvale loam was 2.6 ± 1.5. The corresponding figures for 34 trees in four rows on East Shepparton sandy loam was 70 ± 26.

Orchard 2.—According to Skene and Freedman (1944) there are five soil types in the site of the Levis Cling block on orchard 2. Two of the types are Orrvale and Shepparton loams, the third is Shepparton sandy loam, part of which is a deep surface phase, the fourth is Broken sand and the fifth a grey, sandy depression.

Counting the rotted fruit on the heaviest types (the loams) and on the lightest types (the sand and sandy depression) would have given figures of the same order as those of orchard 1 above. Pick-

ing was in progress, counting was therefore impracticable, consequently estimates which had been made two days before picking were checked with the numbers of brown-rotted fruit rejected by pickers. The percentage loss was less than five per cent. on the two loams, less than 10 per cent. on the sandy loam, and more than 75 per cent. on the sand and grey sandy depression.

Orchard 3.—Most of the portion of this orchard planted to Levis Cling is a sandy loam, the rest being a loam (Butler *et al.* 1942). The loss by brown rot on the sandy loam exceeded half the potential crop. On the loam, and on an adjoining portion of sandy loam which is not easily permeable to water, it was about one per cent.

Skene and Freedman (1944) state that Shepparton soils cover a wide range of permeability to water, some of the types such as the Shepparton and East Shepparton sandy loams being capable of becoming temporarily waterlogged because they absorb water readily. Perched water-tables form on the impermeable strata below. They discuss the problem of excess soil water from seepage from irrigation channels, waterlogging after rains, and drainage difficulties. These factors are considered by them in relation to the dying of peach trees in wet years. From the data herein, excess precipitation, inadequate drainage and consequent waterlogging have a clear bearing not only on the dying of trees, but on the incidence of brown rot.

In dry seasons no such contrasts in brown rot incidence as are here recorded were observed in these orchards. Excess soil moisture, which was differentially associated with the soil types during and after wet weather, was therefore the main causal environmental factor. Temporary covers over some individual trees during rain might help in elucidating subsidiary factors.

At present it is not known whether loss on light soils in brown-rot seasons is compensated for in dry seasons by higher yields than on loams. In dry seasons the disease is endemic, the loss being negligible. A comparative study of peach culture on loams and on lighter soils appears desirable. When replanting light soils becomes necessary, it may be well to consider the relative merits of planting hitherto unplanted loams and replanting lighter soils. Yields on replanted land are known to be lower than on fresh ground.

The lower return on replanted land, and liability to brown rot may reduce the mean yield to less than the reputed yields on loams. Presumably too, methods may be developed for improving the yield on loams.

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THE ROLE OF THE BICARBONATE ION IN LIME INDUCED CHLOROSIS

Lime induced iron deficiency (lime induced chlorosis) is an important nutritional disorder affecting a wide range of horticultural crops. In Victoria it is of considerable economic importance to fruitgrowers in areas of alkaline, highly calcareous soil in the Mid-Murray Irrigation area and on Wimmera clay loams near Horsham.

Immobilization of iron within the plant is now accepted as the direct cause of the observed chlorotic leaf symptoms, but little is known about the relationship between the high lime content of soils in which the disorder occurs and the disturbed iron metabolism of the chlorotic plants. High phosphate content as well as high manganese content of soils is sometimes associated with iron deficiency, but Thorne (1950), reviewing this subject, does not think that these relations are important factors on most soils. Earlier workers, Loehwing (1928), Oserkowsky (1932), and Ingalls and Shive (1931) investigated the relationship between the pH of plant sap and its content of soluble iron. Small (1946), reviewing their work, believes that there is a causal relationship between soluble iron and the pH of plant sap. More recently, Harley and Lindner (1945), observing apple and pear trees and Wadleigh and Brown (1952), working with beans conclude that bicarbonate accumulation in irrigation water in the soil and on the root surface is responsible for the occurrence of "lime-induced" chlorotic symptoms in these plants.

The work reported here is concerned with the relation of bicarbonate accumulation in citrus roots to the H ion concentration of the root sap and its bearing on the causal mechanism of lime induced iron deficiency.

Plant sap is a well buffered solution of inorganic salts, organic acids and proteins. Citrate, malate, phosphate and bicarbonate are the dominant buffering constituents and Small (1946) has emphasized their importance in enabling the plant to adapt itself to highly acid or alkaline soils. For expressed root sap, the initial pH usually lies in the region of pH 5.8-6.4 with a maximum buffer capacity on the acid side of this range, ($\beta = 0.042$) at pH 4.5, while buffer values on the alkaline side are much lower. Careful titration of plant sap also enables the identification and quantitative estimation of the buffering ions.

Experimental

Fibrous roots and leaves of lemon and orange trees growing on alkaline, calcareous soil at Tresco near Swan Hill and on acid soil at Burnley near Melbourne were collected and carefully washed to remove all adhering soil. The roots were dried with blotting paper, then finely ground and mixed with twice their weight of water. The pH of the resultant suspension was determined with a glass electrode. The suspension was then titrated with 0.09N HCl and 0.06N NaOH in approximately 0.2 ml. steps. From the resultant titration curves the buffer-index (β) was calculated, this is the number of gram equivalents of acid or base required per litre, to change the pH of the buffer solution by one unit, Small (1946, p. 16). The work was done in July, 1952, and repeated with similar results in July, 1953.

Results

1. *Leaves*:—There was no significant difference between the titration curves

of macerated leaves from chlorotic and healthy citrus trees or between leaves from trees growing on acid or alkaline soils.

2. *Roots*:—A summary of the relevant information is set out in Table I.

(a) pH of root sap:—As might be expected, the root sap of orange trees growing on alkaline soil has a lower hydrogen ion concentration than that from tree roots growing on acid soil. Where the soil contains lime there is a further decrease in the H ion concentration of the root sap. Roots of chlorotic (iron deficient) orange trees had the highest internal pH.

(b) The buffer capacity of root sap:—Wide differences were shown in the buffering curves of the root extracts from trees growing on various soil types. Chlorotic trees, and to a lesser extent healthy trees on calcareous soil, showed a very high buffer capacity in the range pH 6.2-6.4. High buffer activity at this pH range coincides with the buffer action of the bicarbonate ion which would indicate an accumulation of this ion in the roots of chlorotic trees. This was confirmed by chemical analysis of the roots.

(c) Calcium and carbonate content of roots:—Expressed as percentage of dry weight, roots from chlorotic trees contained more Calcium (1.7%) and more Carbonate (2.4%) than roots of healthy orange trees growing on similar soil (1.1% and 1.1% resp.)

Discussion

A stable internal environment is essential for the efficiency of the complex metabolism of animals and of higher plants. These results indicate that the internal environment of chlorotic citrus roots is disturbed by the accumulation of bicarbonate with its resultant effect on the H ion concentration and buffer capacity.

Wadleigh and Brown (1952) support the view that the bicarbonate ion "may be the primary malefactor under conditions effecting lime-induced chlorosis" but they believe that its role is limited to its effect on the external surface of the root and on mineral absorption. While our results confirm the importance of the bicarbonate ion in lime induced iron deficiency, they suggest that the root of the chlorotic plant absorbs and accumulates bicarbonate as well as calcium. The toxic effects of this internal HCO_3 accumulation on CO_2 excretion accompanied by a rise in the internal pH, are likely to be one of the main causes in the general metabolic disturbance which is asso-

TABLE I

Titration of Macerated root suspension.

(All trees on Citronelle rootstock.)

Scion	Location	Initial pH of tissue	Buffer Index at pH 6.2	Soil pH
Lemon .. .. (Healthy)	Burnley	5.75	.006	4.7 Silurian clay-loam
Orange .. .. (Healthy)	Tresco	6.50	.009	8.7 non-calcareous sandy loam
Orange .. .. (Healthy)	Tresco	6.82	.020	8.7 calcareous loam
Orange .. .. (Chlorotic)	Tresco	7.25	.052	8.6 calcareous loam

ciated with the symptoms of iron deficiency in plants.

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A MODIFIED COLORIMETRIC METHOD FOR THE FIELD DETERMINATION OF SOIL NITRATE

Summary

A colorimetric method using brucine for the field determination of soil nitrate-nitrogen is described. The method is a modification of that proposed by Morgan (1941) and described by Peech and English (1944). The advantages and disadvantages of the method are discussed. It is rapid, requires comparatively little equipment and is well adapted for field use. An accuracy to the nearest part per million is attainable.

Introduction

Current work being undertaken by the University of Queensland Department of Agriculture involves the periodic determination of soil nitrate-nitrogen under various cropping systems. Standard laboratory procedures for their determinations, including stabilising the nitrate in soil samples, are precluded by the remoteness of the experimental sites and transport difficulties and it has been necessary to develop a field technique for use "in situ" with a limited amount of equipment.

A search of the literature revealed that a number of microchemical soil tests have been used by workers with varying success. After trials of these methods the technique finally adopted was a modification of the brucine test proposed by Morgan (1941) and described by Peech and English (1944). The test is a colorimetric one, giving reproducible results accurate to $\frac{1}{4}$ p.p.m. with prepared solutions of known concentration.

Description of the Modified Brucine Method

Reagents

(1) Morgan's extracting solution.—Dissolve 100 g. of A.R. sodium acetate in 1 l. of distilled water. Add 30 ml. of A.R. glacial acetic acid. Render nitrate-free by the addition of a little powdered zinc. The solution should have a pH of 4.8.

(2) Concentrated sulphuric acid (S.G. 1.84).

(3) Brucine solution (5% w/v.)—Dissolve 5 g. brucine in 100 ml. of glacial acetic acid.

(4) Distilled water (for washing).—Render nitrate-free by the addition of a little powdered zinc.

Standard Colour Discs

The colour intensities developed by this technique are matched against those on a

standard disc in a "Lovibond" comparator. The discs have recently been manufactured in England by Tintometer Ltd. and they and the "Lovibond" comparator are described and illustrated by Nicholas (1953). Because of delay in obtaining the discs, the authors have prepared their own set of colour standards and calibrated them against standard nitrate solutions.

These standards can be made from "Ilford" gelatin photographic filters, using Yellow Filter No. 104 (either Alpha, Micro No. 8 or Chromatic No. 2) and Yellow Filter No. 110 (either Minus Blue or Micro No. 4). One thickness of No. 104 in the comparator gives a colour corresponding to that developed in the presence of 1 p.p.m. of nitrate-nitrogen in the soil extract. One thickness of No. 110 corresponds to 9 p.p.m. of nitrate-nitrogen. The discs are prepared using different numbers of filter thicknesses to read from 1 to 18 p.p.m. of nitrate-nitrogen in the extract. However, colour intensities in the 10 to 18 p.p.m. range are difficult to distinguish and it is considered more accurate to adjust the ratio of soil: extractant, where necessary, to obtain readings in the range of 1 to 9 p.p.m.

Method

A 4 g. sample of soil is placed in a No. 2 Whatman filter paper in a funnel and leached with Morgan's extracting solution from a wash bottle, until 10 ml. of leachate are collected in a measuring cylinder. The leachate is agitated, a 2.5 ml. aliquot taken into a 30 ml. beaker and 0.25 ml. of the brucine solution is added from a dropping tube. The mixture is shaken and 5 ml. of concentrated sulphuric acid are poured slowly down the side of the beaker from a 5 c.c. Kipps Automatic Pipette. If the acid is added too fast, ebullition will occur causing splashing and spilling. The beaker is shaken well and allowed to stand for 7 minutes, by which time a permanent yellow colour develops. (A red colour develops initially but quickly changes to yellow.) The intensity of the colour developed is directly proportional to the amount of nitrate present and is measured in the comparator. A "blank" determination on the reagents is necessary. As 2.5 ml. of leachate are collected for each gram of soil the results must be multiplied by 2.5. Correction is also made for the moisture content of the soil to express the results on an oven-dry basis.

Discussion

The brucine method of nitrate-nitrogen determination requires no elaborate apparatus, it is sufficiently accurate for most practical purposes and it is rapid. A batch of 10 samples can be analysed in 1 hour.

As small samples are used, care must be taken that the soil is well broken and mixed during sampling. Despite the smallness of the samples, the authors have found close agreement between replicates.

Peech and English (1944) use an equilibrium extraction technique but leaching gives satisfactory results for nitrate determinations, where the ion is readily soluble and not strongly held on the exchange complex of the soil. Tests showed that the first 10 c.cs. of leachate contain all the nitrate obtainable by leaching.

Recovery of nitrate from the soil is excellent. Tests made by the authors of recovery of added nitrate from the soil have given up to 100% with an average recovery of 98%. Correlation between expected and observed results was very good with a correlation coefficient of 0.97.

Nitrite-nitrogen is also determined by this method and included with nitrate-nitrogen in the final result. Piper (1947) points out that nitrites are seldom present in soils in appreciable amounts.

Peech and English (1944) found that the brucine reaction was remarkably free from interference by extraneous ions in soil extracts. Tests have shown that soils high in soluble organic matter are likely

to give coloured extracts on leaching, but Peech (1948) has found that addition of calcium hydroxide, or alternatively, copper sulphate and calcium carbonate, to the aqueous soil suspension in the extraction process will assure colourless extracts with all soils.

With experience in reading the Comparator it is possible to estimate differences of $\frac{1}{4}$ p.p.m. in the leachate, so an accuracy to the nearest p.p.m. in the soil is easily attainable.

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MOSAIC OR BLACK STREAK DISEASE OF *CYMBIDIUM* AND OTHER ORCHID HYBRIDS

This disease was first described on *Cymbidium* orchids by Magee (1943), who expressed the opinion that the disease was caused by a virus though experimental evidence was not obtained. Subsequently, Jensen (1951a) reported a similar disease in *Cymbidium* orchids in America and demonstrated, by sap transmission from *Cymbidium* to *Cymbidium,* that it was caused by a virus. He found it to be a stable virus, readily sap transmissible, with a thermal inactivation point between 65 and 70°C. and a host range limited to members of the *Orchidaceae.* Electron micrographs of the virus particles show them to be sinuous rods with a mean size of 18 × 475 $m\mu$. (Gold and Jensen 1951).

Sap transmissions were made at Sydney from a *Cymbidium* plant showing symptoms resembling the mosaic or black streak disease, described by Jensen (1951a), on to symptomless *Cymbidium* plants derived from back bulbs. All inoculated plants developed a chlorotic

Figure 1.
Local necrotic lesions developed on Datura stramonium 10 days after inoculation with Cymbidium mosaic virus.

streaking on the newly formed leaves six weeks after inoculation. As these leaves matured the necrotic spotting and streaking developed, similar to that described by Jensen. Sap inoculations were also made on to *Datura stramonium, Nicotiana glutinosa* and *Nicotiana tabacum* var. Hickory prior. No symptoms developed at all on *N. glutinosa* or *N. tabacum* but on *Datura stramonium* small local necrotic lesions developed on the inoculated leaves about 10 days after inoculation; Figure 1. Using this local lesion reaction it was found that the virus in *Cymbidium* had a thermal inactivation point between 65 and 70°C. It would appear from the symptoms on *Cymbidium,* the sap transmissions, and the thermal inactivation point, that Jensen's opinion is confirmed. Namely, that the disease described by Magee is the same as that occurring in *Cymbidium* orchids in America.

The local lesion reaction on *Datura stramonium* appears to be a reliable and relatively rapid means for the identification of mosaic or black streak virus of *Cymbidium.* The virus is widespread amongst *Cymbidiums* grown in Australia and plants showing different degrees of symptom severity have given the local lesion reaction. Symptom expression appears to be affected by light, the symptoms appearing more severe under conditions of high light intensity. Plants with severe necrotic leaf streaks have a higher concentration of virus, as measured by the relative numbers of local lesions developed on *Datura stramonium,* than those with milder symptoms.

The typical local lesion reaction on *Datura stramonium* was obtained when sap inoculations were made from some intergeneric orchid hybrids suggesting that these were also affected by the *Cymbidium* mosaic virus. It appears that the prevalence of intergeneric hybrids amongst members of the *Orchidaceae* has resulted in a wide range of symptom expression to this virus. A species of the trigeneric hybrid *Brassolaeliocattleya,* with sunken necrotic areas on both leaf surfaces and some internal necrosis of mesophyll tissue gave the local lesion reaction on *Datura stramonium.* This reaction was also obtained when sap transmissions were made from a bigeneric hybrid *Odontioda zizette* whose leaves showing chlorotic and necrotic streaking, from *Odontoglossum vuylstekera* with a water-soaked chlorotic mottle and necrotic line pattern and flecking on its leaves, and from *Laeliocattleya antian.*

No records of virus diseases of *Brassolaeliocattleya, Laeliocattleya* or *Odontioda* orchids could be found but Jensen (1951b) has described a ring spot virus disease of *Odontoglossum* orchids, the symptoms of which in no way resemble those described above and which he reported to be incapable of transmission to *Datura stramonium.* Sap transmissions from a *Zygopetalum* produced typical local lesions and Jensen (1953) experimentally transmitted Cymbidium mosaic virus to this host. The local lesion reaction was also obtained when sap transmissions were made from *Dendrobium nobile* and Jensen (1952) records Cymbidium mosaic virus from this host.

That other viruses or strains of Cymbidium mosaic virus occur in local orchids is suggested by the fact that sap inoculations made on to the three indicator plants, *Datura stramonium, N. glutinosa* and *N. tabacum* from a Cymbidium showing only mild mottle symptoms resulted in local lesion development on *N. glutinosa* 10-14 days after inoculation, but no reaction on *Datura stramonium* or *N. tabacum.*

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THE PROTEIN CONTENT OF WHEAT VARIETIES GROWN IN STANDARD PLOTS AND SPACED ROWS

The suitability of wheat for bread-making purposes is influenced by both the quality and the quantity of the protein in the grain. Considerable attention has been given by plant breeders to the improvement of the protein quality, and, latterly, renewed attention is being given to the possibility of breeding for higher grain protein content.

In the early stages of the production of new varieties by a hybridization programme, it is usual to grow the crossbred material in spaced rows. These rows are often spaced 14 or 16 inches apart. If selections for grain protein are to be made at this stage, it is important to know whether the wider spacing has any influence on the capacity of varieties to produce grain protein.

To obtain data on this matter, during the years 1948 to 1951, the varieties in the main variety trial at Longerenong Agricultural College, Victoria, were also sown in rows spaced 14 in. apart. The variety trial plots are 1/40th of an acre in area, being 13 hoes wide and 217 links long. The spaced rows were sown on the same day as the variety trial, and immediately adjacent to that trial. At harvest time, grain samples were taken from the plots and the rows, and the protein content of the grain was determined at the State Laboratories by the Kjeldahl method. The results of these analyses are given in Table I.

It will be seen that, in each year, the average protein of the grain from the plots was lower than that from the rows.

TABLE I

Protein Content of Wheat Grown in Standard Plots and Spaced Rows. (Average Protein Content per cent. on 13.5 per cent. Moisture Basis)

Year	No. of Varieties	Plot	Row	Difference: Row-Plot	
				Average	Range
1948	12	9.6	10.1	+0.5	−0.1 to +0.9
1949	7	9.5	10.0	+0.5	+0.1 to +0.9
1950	8	7.7	8.3	+0.6	+0.2 to +1.0
1951 Sown June	8	7.3	8.2	+0.9	+0.4 to +1.3
1951 Sown July	8	8.0	9.2	+1.2	−0.1 to +1.9

Over the period, the average difference was 0.7%.

As the varieties in the variety trial are changed from year to year, only five varieties occurred in each of the five sowings. These were Pinnacle, Quadrat, Magnet, Insignia and Pindar Selection. An analysis of variance on the differences in protein content (Row-Plot) for these varieties and sowings showed that the differences due to varieties or to seasons were not significant.

Using the data of the 43 comparisons between plots and rows, the correlation coefficient (r) is 0.89, and is highly significant. Thus, approximately 80% of the variation in row protein can be explained by the standard plot protein.

The data therefore show that the protein content of grain grown in spaced rows is higher than that in standard plots, but that the correlation between the protein of grain from plots and rows is sufficiently high to enable the use of spaced rows for selection of this character.

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(*Received for publication, November* 5, 1954).

A NOTE ON THE NUTRITION OF THE SULTANA BUNCH

Winkler (1932) in an extensive series of experiments showed that elaborated food-stuffs in the vine could move readily through quite considerable distances and through wood several years old. His experiments included the variety Thompson Seedless which is the same as the Sultana grown in Australia. With this variety he showed that bunches on defoliated shoots at the apical end of a cane matured almost as well as control bunches although the nearest shoots with leaves were at the base of the cane. He concluded that synthesized foods must move readily among different parts of the vine so that, within limits, they are equally available to any bunch regardless of its position.

Similar conclusions may be drawn from the results of an experiment carried out at the Commonwealth Research Station, Merbein. Two fruitful shoots were chosen on each of 29 vines, one on each side of the vine, such that for each pair the shoots themselves and the bunches borne by them were of about the same size. One shoot of each pair was tagged and retained as a control while the other was cut off above the bunch or bunches (some pairs had two bunches on each shoot) and all leaves on the lower part of the shoot were removed. This was done on November 28 and 29, 1949, after the berries had set but before they had grown appreciably.

Winkler does not state the stage at which the leaves were removed nor whether the shoot was cut back. He left one leaf on each defoliated shoot to prevent the shoot and its bunch from withering. In the present experiment there was no case in which the shoot or bunch withered although all leaves were removed.

The bunches were harvested on February 6, 7 and 8, 1950, the bunches from each pair of shoots being harvested at the same time. This was earlier than the normal picking date, but it was thought advisable to harvest the bunches before mould damage could occur, following rain on February 1 and 5. The bunches were

weighed, then crushed immediately and the sugar content of the juice determined with a refractometer. Winkler gives sugar content, acidity, and berry size, but does not give the actual weight of fruit per shoot. In the Merbein experiment, the mean weight of fruit per shoot for the control shoots was 612.9 g. and the mean sugar content was 9.15° Baumé. For the truncated and defoliated shoots the corresponding means were 607.8 g. and 8.76° Baumé. Analysis of variance showed that for both weight and sugar content there were highly significant differences between the means of the pairs of shoots from different vines, but that the differences between the means of the control and treated shoots were not significant. The differences necessary for significance at the 5% level between these means were 97.3 and 0.43° Baumé respectively. It would appear therefore that food materials must have been as readily available to the bunches on the stubs of the truncated shoots as to other bunches on the same vines. It is also of interest to note that some of the truncated and defoliated shoots matured into canes which would have been suitable for retention at pruning, except that they were too short, so that this maturation also was apparently unaffected by the treatment. Winkler does not state whether any of his shoots matured in this way.

The results suggest that the foodstuffs in the vine form a "pool" from which all bunches and shoots can draw, and that any operation which decreased the capacity of the vine for producing foodstuffs, e.g., topping or late disbudding, would be detrimental in that it would decrease the amount in the "pool." This is in agreement with the findings of Thomas and Barnard (1937). It is of course appreciated that operations such as topping or disbudding may sometimes be desirable for other reasons.

A. J. ANTCLIFF.

C.S.I.R.O.,
Commonwealth Research Station,
Merbein, Victoria.

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(*Received for publication January* 29, 1955.)

AN EPISCOPIC PROJECTOR

TO TRANSFER DATA FROM AERIAL PHOTOGRAPHS TO A BASE PLAN

The instrument illustrated in Figure 1 has been designed so that field data can be more easily and more accurately transferred, with or without a change in scale, from aerial photographs to base plans. It consists of a heavy base stand carrying a tiltable drawing table and a vertical column from which are supported a light box and a lens mounting, both being free to move up and down the column through a specially constructed friction drive. The overall dimensions of the instrument are 3 ft. 6 in. x 2 ft. x 1 ft. 8 in. and it is readily portable.

In the present model the light box permits an object size of 6 in. x 5 in. to be projected. By suitable adjustment, the scale in the image can be continuously altered from a 1 : 1.25 magnification to a 1 : 0.25 reduction. Thus, changes in

scale from photograph to photograph can be compensated for and by using the tiltable table, some of the distortion effects inseparable from aerial photography can be reduced. Although this particular instrument has been designed primarily for reduction work, it could, by use of a longer focal length lens, be very simply made suitable for enlargement work.

The instrument is quick and simple to use. The light box and lens mounting are set to markings on the vertical column according to the relative object : image scale desired, a photograph is put under the trapdoor, and the relevant part of the base plan lined up with the resultant image. The lens is stopped down with the iris diaphragm to produce a suitable relative intensity between the base plan markings and the image of the photograph. With the help of a mounted magnifying viewer an accurate trace can then be made from the photograph to the base plan of such detail as soil boundaries, waterways, internal subdivision of properties, land use practices, dams and improvements, etc.

The final design and construction of the instrument is due in very large part to Messrs. D. H. Schultz and J. H. Williams, of Laubman and Pank Ltd., Adelaide. Further details of the construction of the instrument, as well as of a new model to be mounted on a wall, are available in an internal Technical Memorandum of the Division of Soils, C.S.I.R.O., Adelaide.

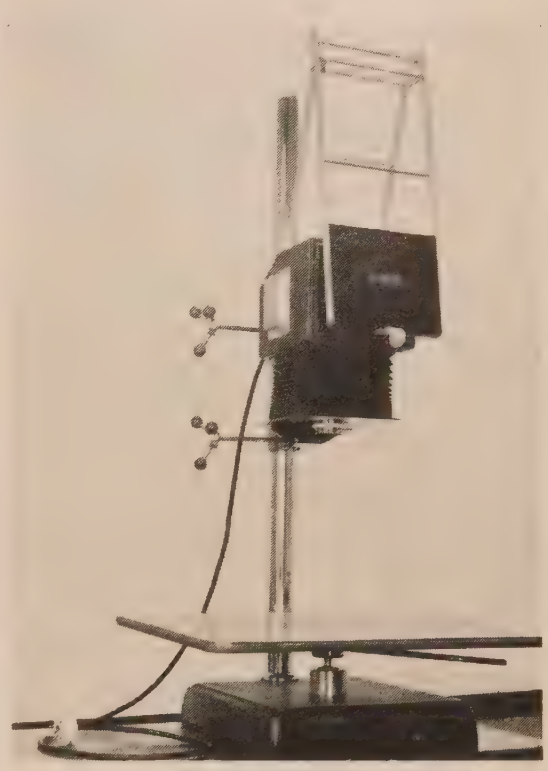

Figure 1.
Prototype model of a portable episcopic projector.
—Photograph by K. H. Phillips.

C. B. WELLS.

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Waite Agricultural Research Institute.
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(Received for publication November 30, 1954.)

A FERTILIZER DISTRIBUTOR FOR POTATO TRIALS

For many years the conduct of fertilizer trials with potatoes in the field has posed problems in obtaining precise application and uniform distribution of the fertilizer materials. It has been necessary to distribute the fertilizer by hand, which has been unsatisfactory inasmuch as it introduces factors that may affect the reliability of the results obtained, e.g., wind drift, uneven distribution, improper placement and leaving the planting furrow open for several hours.

In June, 1950, Cumings, Hulburt and Eldredge (1950) described a distributor that had been developed at Beltsville, Md., U.S.A., primarily for the application of radio-active fertilizer materials. The distributor consisted simply of a stationary hopper with an endless belt bottom. The required amount of fertilizer to be applied to a single row plot is spread uniformly over a section of the belt known to ensure complete application to the plot. As the machine travels forward over the row, the fertilizer is delivered at a uniform rate, being completely discharged at the end of the row, thus the distributor has the advantage of being self-cleaning.

In 1953, a similar distributor was constructed by the writer, incorporating modifications demanded by local conditions of use. In the past two seasons it has been employed at the Potato Research Station, Healesville, and is found to be extremely efficient.

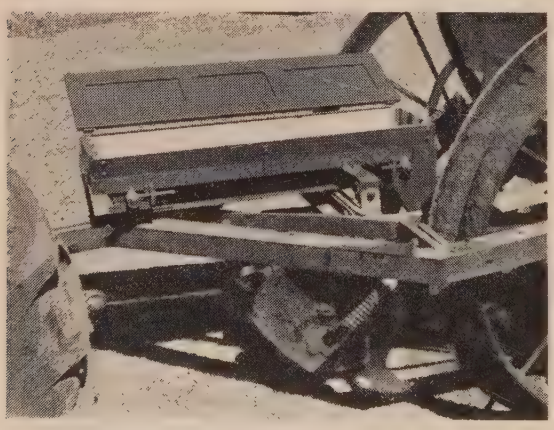

Figure 1.
The distributor fitted to an "Iron Age" potato planter. The delivery spout is at the right-hand end and feeds the fertilizer down behind the opening discs of the planter.

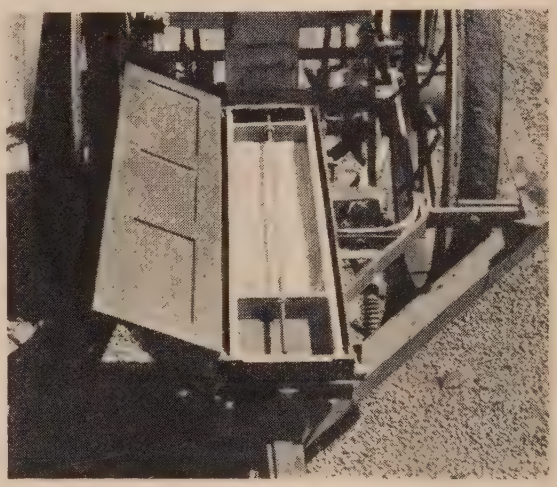

Figure 2.
Showing the removable baffle in position on the belt with fertilizer levelled out. The belt moves in an opposite direction to that in which the machine is travelling.

The distributor is fitted on to the front of an "Iron Age" assisted-feed potato planter in place of the normal fertilizer hopper and utilizes the same drive. Fitted in this position, the delivery hoses feed down into the furrow opener that is part of the potato planter, thus the fertilizer is placed in its correct position, that is in two equal bands two inches away on each side of the seed piece.

Operation

The fertilizer trials on potatoes sown in Victoria are of factorial design, having

a standard plot size of 4 rows 33 feet in length.

In operation, the potato planter with the distributor in position is simply stationed a short distance away from the end of the row to allow the fertilizer flow to reach the ground as the delivery tubes move into line with the end of the row. A baffle is put in place and the fertilizer spread uniformly over the surface of the belt. The baffle is withdrawn, and the machine moves down to the end of the row, where the last of the fertilizer is discharged, and continues across the pathway to stop in position ready for the next plot.

Comment

The fertilizer distributor described has been found highly satisfactory when used in conjunction with a potato planter for sowing fertilizer trials. As the original designers claim (Cummings et alia, 1950) it appears to be a versatile piece of equipment that can be adapted for use on practically any implement and for different methods of application of fertilizers to various row crops.

References

Cumings, G. A., Hulburt, W. C. and Eldredge, D. B. (1950)—Development of a dispenser for applying radio-active phosphatic fertilizer. Agric. Eng. 31: 275-77.

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(*Received for publication, January* 28, 1955.)

BOOK REVIEWS—

METHODS OF SURVEYING AND MEASURING VEGETATION

By DOROTHY BROWN

(*Commonwealth Bureau of Pastures and Field Crops Bulletin, No.* 42, 1954, *p.* 223; *obtainable from C.A.B. Liaison Officer,* 314 *Albert Street, East Melbourne. Price,* 43/9.)

The methods are classified not primarily according to the type of vegetation on which they are employed but on the basis of botanical analysis, productivity, and utilisation. The book deals with (a) vegetation and its sampling; (b) botanical analysis, using the criteria of frequency of occurrence, number, area covered, and weight; (c) productivity, covering estimate of error, weight estimate, area and weight, actual weight, the animal as a measure, and pasture recording and regional surveys; and (d) utilisation, including weight, linear measurements, and reconnaissance methods. At most stages attention is directed to statistical considerations and quantitative ecology.

The book will undoubtedly encourage a wider and more intelligent use of many methods and will stimulate work on critical comparisons of different methods.

C.A.B.,
Liaison Officer.

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INSTITUTE AFFAIRS

BRANCH NOTES

Australian Capital Territory

On 9th November Professor E. J. Underwood delivered an address entitled "Agricultural research activities of the University Institute of Agriculture, Perth."

In his opening remarks Professor Underwood pointed out the way in which the Institute differs from an ordinary University Department. The Institute houses the teaching faculty of the University and as well it has fairly substantial outside funds which are available for research. These funds are under the direct control of the Director and do not go through the University channels.

The work of the Institute consists of general agricultural research and applied research in the field of agriculture conducted in such a way as to answer questions of a fundamental nature.

If such a body is to be an agricultural research institute in fact, it should undertake research on a broad front. Problems should be tackled as they appear in the field and as they are raised to enable staff and students to have some impact on a wide field of knowledge. The purpose of the institute is to maintain the calibre of its teaching staff and to prevent it losing touch with industry and to train graduates over a wide range of agriculture. Research is carried out in four main lines—soils, plants, animals and agricultural economics.

(a) *Soils*: Within the grounds of the Institute a Section of the C.S.I.R.O. Division of Soils has been established and this is undertaking soil survey work for the State. In the State Department of Agriculture there is a group which is interested in problems of soil fertility. The Institute does not tackle work in either of these fields.

Work is being carried out by the Institute on fertility problems of soils with regard to nitrogen and a study of chemical changes in the soil under varying rotations with and without legumes. Work on counting techniques for organisms has shown promising results.

(b) *Plants*: Investigations are being made of the decline in soil fertility and the possibility of building up fertility by the use of legumes. In Western Australia the climatic and soil range over which known legumes are effective is relatively restricted, and there is room for work of legume breeding. A programme of grass breeding and selection of subterranean clover has been started. This is a very difficult field of research and problems have been encountered in obtaining viable seed from the crosses. There is a basic programme of research in problems of seed-setting in sub. clover.

A collection of native legume species of *Swansonia* and *Kennedya* is being made together with a cytological examination of all the species The problems of germination and establishment of a few selected species of each genus are being examined.

Studies are being carried out on the lupin because of the special place it has in parts of Western Australia. A collection of strains and species is being examined for the production of a high yielding non-shattering type free from alkaloid.

(c) *Animal Research*: This is restricted very much to certain aspects of nutrition and physiology of wool sheep because of limited field facilities. The work on the role of micro-flora of ruminant sheep is concerned with studies of the organisms within the sheep and some studies in the role of those organisms in the utilization of non-protein sources of nitrogen. The relationship between nitrogen and sulphur in the ruminant has been found to be very similar to the relationship established for plants and for micro-organisms.

(d) *Agricultural Economics, Farm Management and Rural Sociology*: The objective of this group is to study how economic and social factors in farming influence the efficiency of farming. Use is made of the random survey methods of particular industries or districts and personal interview at the farm of the farmer and his family to obtain personal records and production and financial records.

Such a survey has been made of the butter fat producing areas. It was found that the two most significant factors influencing the success of the dairy farmer are credit availability and the extent to which the farmer applies existing technical knowledge provided by the State Department experts. This dairy survey revealed that no less than 80 per cent. of the farmers had left school at Standard 6 at the age of 14. There were usually no books in the home and it was recognized that extension work through written matter was useless. Personal approach must be used.

In a survey of wheat and sheep farms enquiries were made as to the extent to which summer supplementary feed and fodder conservation was carried out. Of 500 farms, it was found that 76 per cent. did not feed even up to the minimum level recommended by the State Department of Agriculture.

It has been recognized that there should be a continual appraisal of farm practices by surveys to find out the extent to which farmers are making use of extension services. Professor

Underwood pointed out the great advantage of this type of survey being done by the Universities because of their independence from the Government.

Professor Underwood concluded by pointing out that the Institute was obtaining worthwhile results in the field of agricultural research. Also, there had been no difficulty in securing young workers for the staff because of the attractiveness of the lively group at the Institute.

On 6th December the meeting took the form of a symposium on Papua/New Guinea. The speakers were Mr. W. Granger and Mr. J. O. Smith.

Mr. Granger discussed "The Background and Scope of Animal Industries in Papua and New Guinea." In opening his address, he showed slides relating topography, rainfall and vegetation to potential grazing areas and discussed the suitability of the various environments for stock raising.

During the war a veterinary survey had been made and action had been taken to counter the risk of introduction of epizootics by the Japanese. Since the war a Division of Animal Industry had been established in the Department of Agriculture, Stock and Fisheries of the Administration; also C.S.I.R.O. and the Administration had commenced a physical resources survey of the Territories.

Native agriculture was a shifting system employing a bush fallow rotation. Natives had no livestock suited to domestication other than the pig which was an object of wealth and prestige rather than a farm animal. The scope for native animal industry was to correct the dietary deficiency of protein, provide cheap transport for distribution of inducement goods and marketing of products like peanuts and coffee, to conserve (and increase the yield of) the grasslands pending their more intensive use and to enable transition to permanent systems of agriculture.

Until recently, although horses had been used, animal industry by Europeans had been a mere sideline to plantation agriculture and mission subsistence farming. The scope for development here was to supply the considerable local demand for animal products, to enable mixed farming, to stock the plantations, to pioneer areas for more intensive development, and to conserve the grasslands. Production of meat and dairy products for export was a longer-range possibility.

Veterinary problems included cattle tick and the associated fevers, screw-worm fly, internal parasites, and anthrax. The broad problem would rise from bridging the gap to the south-west of Wallace's line which at present separates the livestock and epizootics of South-East Asia from the susceptible populations of Australia.

Two major conclusions made by Mr. Granger are that intensive rather than extensive stock management is more suited to local conditions, and that native industries can develop only by extension, with suitable adaptations, from European industries.

Mr. J. O. Smith then lectured on "Cocoa and Coffee Cultivation and Plantation Processing," first giving a general description of the cocoa tree and types of cocoa used throughout the world. He covered aspects of cultivation in Papua and New Guinea including soils, climate, cleaning and planting (both sole planted and interplanted with coconuts). He also discussed the provision of shade and shade species, weeding, harvesting, pruning and plantation processing. In addition cocoa yields were given and the main insect pests and plant diseases of the crop were referred to.

Coffee types in use throughout the world were described and the environments associated with the *Arabica* and *Robusta* species were explained. Mr. Smith described aspects of cultivation of the crop in the Territories covering soil, climate, cleaning, planting, shade, harvesting, pruning and processing. Aspects of processing included pulping, fermentation, washing, drying and grading. Yield figures were given and reference was made to insect pest and disease problems. However, these pest and disease problems are not serious in Papua and New Guinea.

Queensland

Each year the Queensland Branch Prize is offered for the undergraduate of the Faculty of Agriculture, University of Queensland, who presents the best paper to the November meeting of the Branch. The finalists for 1954 were Messrs. Downes, From and Pollock. The Prize was awarded to Mr. J. R. Pollock for a paper dealing with the control of the giant snail in cacao plantations in New Britain. The paper recorded results of experimental work carried out by Mr. Pollock during long vacation practical work.

South Australia

At a meeting on 12th November, 1954, Dr. C. S. Piper, Reader in Agricultural Chemistry at the Waite Institute, spoke on "Diagnosis of Soil Fertility." Crop yield is a summation of a large number of factors of which the soils chemist can only assess the chemical potential of the soil as it affects yield. To be of use, soil tests had to be on an extensive scale with a background of information obtained from field trials. Results were very empirical and worked best when confined to a single crop or a limited district.

Their application in Australia was further limited by three factors:

(a) the fewer instances of intense cropping,

(b) agriculture is relatively young and fertility has not changed as it has in U.S., U.K., and Europe,

(c) relatively small amounts of fertiliser are used.

Dr. Piper explained the organisation of soil analysis services in several of the States of America where the results were used by advisory services. He also discussed the services provided in Britain and the large Chemical Advisory Service in Holland which analysed 140,000 soil and plant samples per year.

On December 10th, 1954, Mr. F. Pearson, Agricultural Adviser for the South East, dis-

cussed "Pasture Usage in the South East." He outlined the history of agricultural development in the five southern counties which form the South East. Settlement commenced before 1831, but influx of rabbits in 1890 caused the reversion of fairly large areas of white clover pasture. In 1930 supered subterranean clover pastures followed by perennial rye grass commenced a large development and today 100,000 acres, carrying nearly three million sheep, are now under pasture. Mr. Pearson detailed more recent developments which have influenced productivity. The correction of coast disease by treatment with cobalt has given a spectacular increase in productivity of established pasture areas along the coast. Crop production in the Bordertown district has been increased by cutting out fallow. In red gum soils of the higher rainfall areas south of Naracoorte, inclusion of Phalaris in pasture has increased carrying capacity. Clearing of scrub areas since the war by private land-holders, Land Development Executive and the A.M.P. Society has greatly increased productivity of these areas.

Mr. Pearson then discussed probable future developments. He considered the possibility of increasing cereal areas by including two years cropping with eight years of pasture. Pasture irrigation from bores was increasing but the immense possibilities of using drainage water to irrigate better class pasture land had been hardly touched. The Mount Hope drain alone drained a volume of water each year equivalent to the Hume and Eildon dams combined. More information was needed on development and management of pastures but adequate subdivision would lift productivity. He prophesied that the South East could eventually carry nine million sheep and could grow seven to eight million bushels of grain.

Tasmania

On December 10th the Tasmanian Branch held its Annual Dinner and Dance at "The Chalet," Austin's Ferry. Forty members and guests had a very enjoyable evening. Among the guests were the Minister for Forests, Mr. C. Hand, and Mrs. Hand, and the Secretary for Agriculture, Mr. H. C. Smith, and Mrs. Smith. This is the second time that the Branch has held a dinner of this kind and, judging by its success, it seems that the practice will be continued.

ERRATUM: An error occurred in the Tasmanian Branch Notes for the December issue. Volume 20, Page 265, line 7, for "Transmutance" read "Transhumance."

Victoria

Melbourne had torrential rains on two separate occasions this season. Institute meetings coincided with both of them. The first of these meetings was the one on November 9th, addressed by Mr. H. J. Geddes, of the McGarvie Smith Animal Husbandry Farm (N.S.W.) on the subject of "Water Harvesting." Mr. Geddes told the audience of 200 of the work being done at Badgery's Creek on the storage and use of water on the 400-acre farm, and discussed the wider implications of this experiment.

The annual so-called "Garden Party" to welcome new graduates to the Institute was held indoors on December 3rd. Despite the rain, which dislocated all transport, about 80 members and guests attended and gave every appearance of enjoying themselves.

Western Australia

The growth of the Western Australian Branch in recent years was emphasised by the adoption of a new set of By-laws at a Branch Meeting on January 21st. Amongst a large number of revisions which were accepted, was a By-law which *doubled* the number necessary to constitute a quorum for a General Meeting.

At a General Meeting on 1st October, 1954, Mr. A. Syngrassides, a visitor from Cyprus, gave an interesting illustrated address on the natural and social features of that island. The chequered history of the small country has resulted in the current use of three languages—Greek, Turkish and English. Agriculture is the main industry, but an average size of holding of about 20 acres makes the introduction of modern techniques extremely difficult. The soils are mostly developed from limestone and lavas, but much of the island is too rugged for arable agriculture. Fences are rare, and shepherding on rough natural grazing and crop residues is the common form of stock husbandry.

Further information for members concerning agriculture in other lands was given by Mr. G. H. Burvill, Commissioner of Soil Conservation, at a meeting on 21st January, 1955. Mr. Burvill returned recently from the 5th International Soil Science Congress at Leopoldville, Belgian Congo. Mr. Burvill visited other parts of Africa, including the Union of South Africa and Rhodesia. With the assistance of a fine collection of kodachrome slides, he illustrated several patterns of farming in the Cape, Transvaal, and tropical regions. Control measures against soil erosion in areas under cultivation by natives forms a special problem which was graphically described. Many thousands of acres are now contour banked and/or contour planted.

In the Department of Agriculture of the Union, the principals of University Faculties of Agriculture are also regional directors of Research and Extension. This innovation was recent, and it is too early to judge its efficacy as an administrative arrangement.

Speakers at a meeting held on 12th November, 1954, brought some light to bear on problems nearer to home. Mr. F. E. Hitchins spoke on the "Wool Industry," and this was followed by a talk by Mr. A. M. Stewart entitled "Some Technical Aspects of Wool Production."

Mr. Hitchins devoted most of his time to a discussion of changes in wool marketing which have followed major changes in the organisation of the industry, and its place in the national economy. Since Joint Organisation was dis-

banded, there has been no successful attempt to stabilise the marketing of wool in Australia.

Mr. Stewart dealt with one aspect of wool-growing problems—"Which wool to grow." After a close examination of the relationships between wool fibre diameters and prices, and of the difficulties facing producers in adjusting the "count" of their flocks, he concluded that one answer to the problem of choice of wool to produce was "more wool."

PERSONAL NOTES

Australian Capital Territory

Mr. T. G. Campbell, of the Division of Economic Entomology, C.S.I.R.O., Canberra, has been seconded to the Department of Agriculture, Fiji, as Government Entomologist, while Mr. B. Connor is visiting the United Kingdom for six months. On his way to Fiji, Mr. Campbell visited the South Pacific Commission laboratories in Noumea. He is expected back in Canberra in July.

Mr. P. A. Reid has left the Bureau of Agricultural Economics in Canberra to take up a position with the International Bank in Washington.

Dr. O. H. Frankel, Chief of the Division of Plant Industry, C.S.I.R.O., Canberra, made a short visit to New Zealand during October. During this time he visited the D.S.I.R., Palmerston North, and the Wheat Research Institute, Christchurch.

Mr. W. M. Willoughby, Agrostologist of the Division of Plant Industry, C.S.I.R.O., Canberra, is at present on a three months' visit to New Zealand. His visit will take him to the D.S.I.R. Grasslands Division, Palmerston North, and to the Ruakura Animal Research Station, where he will study methods of pasture management and utilization research.

New South Wales

Dr. H. J. Hynes, Assistant Director of Agriculture in the N.S.W. Department of Agriculture, has been on extended leave of absence because of a serious illness. We are pleased to hear that he is expected to be able to return to duty soon. It will be remembered that Dr. Hynes initiated the move for the establishment of the Journal of the Institute and was its first editor during the important early formative years.

Mr. G. R. Gregory, Fruit Research Officer of the N.S.W. Department of Agriculture, is spending a period of 12 months at the Waite Institute where he is making a specialised study of oenology preparatory to taking over as Viticultural Expert in the Department.

Mr. Austin Johnson, for several years district agronomist at Inverell, has recently been appointed Deputy Principal of Hawkesbury Agricultural College.

Emeritus Professor R. D. Watt has been appointed Scientific Adviser to Anderson's Seeds Ltd. It is understood that Prof. Watt will be specially concerned with the company's interests in pasture plants and pasture improvement.

Mr. A. M. Evans, of the A.B.C. Rural Broadcasting staff in Sydney, has been awarded a Fulbright I.T.E. Scholarship and is spending 12 months at the Iowa State College of Agriculture studying rural broadcasting and television. Mr. Evans had been responsible for the production of the A.B.C. feature, "The Land and its People."

Emeritus Professor W. L. Waterhouse was made a C.M.G. in the recent New Year's Honours. This honour is thoroughly deserved by one who has given a lifetime of generous service to the profession of agriculture and to the wheat industry.

Mr. R. W. Jessup, of the C.S.I.R.O. Regional Pastoral Laboratory, Armidale, left Australia in January, travelling to the U.S.A. via New Zealand, Fiji and Hawaii, to take up a Smith Mundt Fellowship at the University of California, Berkeley. He will spend eight months working on problems affecting the south-western arid zone states of the U.S.A.

Recent appointments to the Scientific staff of the N.S.W. Department of Agriculture include:

R. Gartrell and *W. Greenhalga*, to the Division of Horticulture; *I. McLean* (from the N.S.W. Education Department); *S. Grimmett* (from the Queensland Department of Agriculture and Stock) and *K. McWhirter* to the Division of Plant Industry.

South Australia

Dr. H. G. Andrewartha has been appointed Reader in Animal Ecology with the Zoology Department of the University of Adelaide. He commenced duties in the New Year.

Mr. A. G. Strickland, formerly Chief Horticulturist, has been appointed Chief of the newly formed Division of Plant Industry of the Department of Agriculture.

Mr. R. J. Herriott, formerly Chief of the Soil Conservation Branch of the Department of Agriculture, has been appointed Chief of the Division of Extension Services and Information.

Mr. P. C. Angove, formerly General Supervisor, Rural Youth Movement, has been appointed

Senior Agricultural Adviser, Department of Agriculture.

Mr. M. B. Spurling, formerly Lecturer in Horticulture, Roseworthy Agricultural College, has been appointed Senior Horticultural Research Officer, Department of Agriculture.

Tasmania

Mr. F. W. Hicks returned to the State early in December after an extensive tour of the U.S.A. and the U.K. Members are looking forward to a meeting in April when they will have an opportunity to hear Mr. Hicks speaking on his experiences during his travels.

Victoria

Dr. N. McC. Tulloh is in Melbourne again as Assistant Secretary to the Division of Animal Health and Production, C.S.I.R.O.

Mr. A. D. North is now at Werribee in charge of the Department of Agriculture Pig Testing Station there.

Mr. Ivan Tulloh, Principal, Longerenong Agricultural College, has retired.

Mr. Ken Lewis has accepted a position with the Milk Marketing Board in England.

Mr. W. D. Hardy, formerly Assistant Director, Division of Agricultural Production, Department of Commerce and Agriculture, has been appointed Australian Government Trade Commissioner at San Francisco.

Western Australia

Dr. K. W. Finlay has accepted an appointment at the Waite Institute as Senior Lecturer in Plant Breeding and Genetics. He will return to Western Australia for a brief period towards the end of April. At the moment, he is working at Cambridge University.

Mr. J. A. Carpenter has been awarded a C.S.I.R.O. Scholarship to study the genetics of subterranean clover at the University Institute of Agriculture.

Mr. K. Fitzgerald, after a period with the Northern Territory Administration, has rejoined the Department of Agriculture. He expects to be stationed at the Kimberley Research Station.

Mr. D. G. Wilcox has taken an appointment as Adviser in the Department of Agriculture, North-West Branch. He will be stationed at Wiluna.

Scholarships for study at the Institute of Wool Technology, Sydney, have been awarded to Messrs. *J. K. Stott* and *C. Spencer,* of the Department of Agriculture.

Of the 15 graduands in Agriculture this year, one is returning to Ceylon, and eight have accepted appointments with the Department of Agriculture.

NEWS ITEMS

Thirty-first A.N.Z.A.A.S. Meeting, 1955

The Australian and New Zealand Association for the Advancement of Science will hold its 31st meeting in Melbourne from 17th to 24th August, 1955. These meetings are held in rotation in the capital cities of the various Australian states and in New Zealand at intervals of approximately 18 months. The last Melbourne meeting was held 20 years ago and this will now be the 5th occasion on which Melbourne has been the host city.

Sixteen sections covering the various branches of science have been formed. Section "K" which covers the fields of Agriculture and Forestry has A. R. Trist as President and A. L. Tisdall and J. H. Chinner as Joint-Secretaries.

The President-elect of the Association is Professor R. R. Wooley who is Honorary Professor of Astronomy at the National University and also Commonwealth Astronomer at the Mount Stromlo Observatory at Canberra.

It is expected that at least 2,500 members will attend the Melbourne meeting, including over 1,000 interstate and New Zealand visitors.

Most of the sessions and activities of the meeting will take place at the University. Arrangements have also been made for accommodation at the University Colleges or at hotels, and reservations will be made by the Accommodation Committee if desired.

Membership

Persons wishing to attend the meeting may join in any of the categories listed below. No scientific or technical qualification is required for membership.

(1) **Annual Membership** is continuous, and involves the payment of a subscription of £2/2/- per annum. The initial subscription should be forwarded to the Local Secretary of your own State or Dominion. Annual Members have all the privileges of Ordinary Membership for each Meeting of the Association, and receive, in addition, the "Australian Journal of Science" which is issued by the Association.

(2) **Ordinary Membership** covers the current (Melbourne) Meeting of the Association only. It involves the payment of a subscription of £2, payable in advance, to the Local Secretary of your own State or Dominion. The privileges of Membership include the right to attend all general and sectional meetings and lectures and to participate in excursions. Each Ordinary Member receives the Report of the Association for the Meeting, containing the Presidential addresses, the reports of the Research Com-

mittees, selected papers read before the Sections during the Meeting, and other matter. The Report is published as soon as possible after the Meeting.

(3) **Associate Membership** involves the payment of £1 for the current (Melbourne) Meeting, payable in advance, to the Local Secretary of your own State or Dominion. Associate Members are entitled to all the privileges of Ordinary Members except the right to vote at meetings and the right to receive free the Report of the Association for the Meeting.

Associate Membership is restricted to (i) wives of members who do not wish to become Ordinary Members, and (ii) full-time students proceeding to a degree at any University, Technical College, Working Men's College, School of Mines, Secondary School, or other Institution named by the Council in Australia or New Zealand.

Forms for enrolment or accommodation; and any further information required about the Meeting may be obtained from N. H. Olver, Honorary Secretary for the Melbourne Meeting, University of Melbourne, Carlton, N.3., Virtoria.

Prevention of Evaporation from Water Storages

Australia's lower rainfall areas will benefit considerably if C.S.I.R.O.'s experiments on reducing evaporation from water storages prove successful.

Much of our pastoral land lies within the region in which evaporation is more than 72 inches a year—a figure greatly in excess of the rainfall.

In 1940 C.S.I.R.O. supported the late Dr. E. Heymann of the University of Melbourne in his attempts to use thick oil films to prevent water evaporation. His experiments proved successful in the laboratory but the method failed in the field, even on a small scale.

Early in 1953 the C.S.I.R.O. Division of Industrial Chemistry commenced work on films which are only one molecule thick. Although such films are less effective than thick oil films in preventing evaporation, they are much more stable. One chemical tested—cetyl alcohol—shows considerable promise. Under ideal laboratory conditions it reduces evaporation by 80 per cent.

Small-scale out-of-door tests using cetyl alcohol films have now been in progress in Victoria for about 18 months. The results show an average of 50 per cent. reduction in evaporation.

A larger-scale test was conducted last summer on a town reservoir at Woomelang, Victoria. Two acres of water were treated and although the results were complicated by seepage it seems likely that evaporation was reduced by 30 per cent.

Further large-scale tests are to be made during the present summer. In Victoria 19 sites have been chosen ranging from 1 to 60 acres in area; in New South Wales 6 sites ranging up to 350 acres in area; and in Queensland 7 sites all of about ½ acre. One site is already under test in Western Australia.

Until these tests have been completed it is not possible to make practical recommendations for using this technique. It seems that about 1 lb. of cetyl alcohol will be required per acre and that this treatment may last several years. Cost may be about 0.1 pence per 1,000 gallons of water saved.

Cetyl alcohol now comes mostly from sperm oil from whales and total production is relatively small. However, synthetic material can readily be produced.

Grant to Journal from Rural Credits Developments Fund

The Council of the Australian Institute of Agricultural Science wishes to acknowledge the receipt of a third grant of £200 from the Rural Credits Developments Fund of the Commonwealth Bank of Australia.

The Rural Credits Developments Fund was established in 1928 to assist in the promotion of primary production in Australia. Each year half the annual profits from the Rural Credits Department of the Commonwealth Bank are set aside for this purpose and the Bank decides how they will be used. Since the inception of the Fund, a total sum of £770,000 has been made available to various organisations. This has enabled considerable advances to be made in such fields as dairy research, dairy herd recording, the improvement of stud stock, the investigation of fruit culture, and in the combating of plant and fruit diseases.

The Australian Institute of Agricultural Science is the professional organisation of practising agriculturalists in Australia and the Journal of the Institute is its main organ for publicity, for the publication of research and for binding the dispersed membership together. It is unique in Australia in that it is the only Journal which is available for the publication of reviews of the broader aspects of Agricultural Science, and for the important preliminary results of research work. It is financed almost wholly from members' subscriptions.

The assistance rendered to the Institute from the Rural Credits Developments Fund has enabled the Journal to be maintained and expanded in avenues of considerable benefit to the profession of Agricultural Science, and has made it even more useful than formerly. The Council of the Institute is most grateful to the Commonwealth Bank for its assistance.

Reorganization of South Australian Department of Agriculture

During December 1954, the South Australian Government announced a major reorganization within the Department of Agriculture, aimed at improving the effectiveness of the Department as an extension and advisory body.

The reorganization established three divisions, namely, Plant Industry (incorporating the Agriculture, Horticulture and Soil Conservation Branches), Animal Industry (Livestock, Dairy

and Poultry Branches) and a Division of Extension Services and Information.

The chief development is the establishment of the Division of Extension Services and Information. This Division will co-ordinate the work of the Department with formal organizations including the Agricultural Bureau of South Australia, the Women's Extension Services and the Rural Youth Movement. The Division will also supervise the collection and distribution of press and radio publicity and the publication of the Journal of Agriculture.

In service training of the Department's extension officers will also be the responsibility of the Division.

New Officer-in-Charge Sheep Biology Laboratory, Prospect

Dr. I. W. McDonald, H.D.A., B.V.Sc., B.Sc., Ph.D., has been appointed Officer-in-Charge of the C.S.I.R.O. Sheep Biology Laboratory, Prospect, N.S.W.

The C.S.I.R.O. Laboratory at Prospect was established some years ago as a base for laboratory studies and field investigations aimed at developing the full potentialities of the various breeds of sheep in terms of quality and quantity of fleece, higher lambing percentages and specialized breeding. The Laboratory is concentrating on the problems of fertility and reproduction, the physiology of wool production, and sheep breeding and genetics, and it is hoped that this research centre will become the focal point for the collection, analysis and recording of scientific data obtained throughout the world, relating to sheep and wool husbandry.

Dr. McDonald is an Australian, a former student of Hawkesbury Agricultural College, and a graduate of Sydney University. He succeeds Professor C. W. Emmens, Professor of Veterinary Physiology, University of Sydney, who has been acting as Officer-in-Charge of the Prospect Laboratory since 1952.

Retirement of Dr. H. Thompson, Division of Fisheries, C.S.I.R.O.

Dr. Harold Thompson, founder and for 17 years the Chief of the Division of Fisheries of C.S.I.R.O., is to retire shortly at the age of 64. He leaves behind him a large body of knowledge of Australian fisheries and an organization to carry on his work.

The Division of Fisheries under Dr. Thompson's leadership has become one of the leading laboratories of its kind in the world. The Division has contributed much to the establishment and extension of the whale, tuna, crayfish, and shark fisheries. It has shown the need to relax the fishing pressure on certain kinds of fish, while indicating others that might be used to take their place, and it has made considerable strides in the study of the movement and fertility of Australian seawater masses on which all marine life depends.

Retirement of Miss E. L. Archer, Chief Librarian of C.S.I.R.O.

Miss E. L. Archer retired recently from her position as Chief Librarian of the C.S.I.R.O.

Miss Archer has been on the staff of C.S.I.R.O. and its two predecessors (the Council for Scientific and Industrial Research and the Institute of Science and Industry) from the earliest years of their formation, and has had a longer association with these establishments than any other member of the staff. She has built up the library system of the Organization over a period of 30 years, and her responsibility extended beyond the management of the library at Head Office to include the supervision of over 30 Divisional and Sectional libraries distributed through every State of the Commonwealth.

Miss Archer is well known to most Agriculturalists. Furthermore, she has been a tireless worker in the interests of librarians and has done much to raise their status in Australia and to gain recognition for library work as a specialist profession.

Vegetable Research in U.S.A. and U.K.

Mr. A. C. Orman, Principal Agronomist (Vegetables) in the N.S.W. Department of Agriculture has recently returned from America and the United Kingdom where he spent several months studying the latest trends in vegetable production and marketing research.

In America a great deal of attention is being given to all aspects of research at many research centres. It is very evident that American vegetable growers are faced with rapidly increasing costs of production and distribution, and cost reduction is the principal objective of the research programmes. Already much success has been achieved.

In England and Scotland the industry is now much better organised, particularly in the marketing side. Very interesting work is being done, particularly on potato breeding, disease control and storage, at the new Vegetable Research Station at Wellsbourne, the University of Nottingham and other centres.

Mr. Orman believes that recent developments in marketing techniques, especially in the field of pre-packaging, can readily and very usefully be adopted by the Australian vegetable industry.

First Importation of Deep Frozen Semen

A consignment of 20 ampoules of deep frozen Friesian bull semen has been imported from England for use in a private herd in the Werribee A.I. scheme. The semen, which arrived in good condition on December 8th, has been released from quarantine and has been used on a number of cows.

The Animal Husbandry Research Centre at Werribee has arranged details of the importation, storage and use of this semen.

Handbook for Oyster-Farmers

A guide to oyster-farmers has just been issued by the C.S.I.R.O. Division of Fisheries. The handbook deals with each phase of oyster-farming from the selection of grounds to the harvesting and marketing of oysters. It provides information on the various methods of cultivation

and the equipment and material needed for them. One section deals with diseases and pests of the oyster.

At present oyster-farming is practised mainly in New South Wales where a considerable and stable industry has developed. In other States oyster-men rely largely on the natural beds, stripping them and waiting for them to recover, thus providing a low-level fluctuating industry.

There is scope for increased production. Not enough oysters are produced in Australia to cope with the home demand. Test shipments sent overseas, particularly to Singapore and Great Britain, have shown that a large overseas market could be built up.

Most of the grounds in the better-favoured estuaries of New South Wales have been taken up except for those which are reserved as hauling grounds for net fishermen. Better use could be made of many of the beds. More intensive cultivation seems to be the only way the New South Wales industry can continue to expand. In Queensland, northern Western Australia, and Tasmania, many areas are suitable for oyster cultivation and could be farmed profitably.

LETTERS TO THE EDITOR

Sir,

Rust on Euphorbia peplus L.

In your Journal, Vol. 20, No. 3, Sept., 1954, p. 184, I wrote a short note identifying and recording the occurrence of *Melampsora euphorbiae-pepli* W. Müll. on *Euphorbia peplus* L. in Victoria.

At the time of publication, I was not aware that D. E. Finlay (Australian Plant Disease Recorder, Vol. 6, No. 1, Jan. 1954) had already described a rust, on *Euphorbia peplus* collected in the Sydney Metropolitan area in September, 1953, the spores of which, "agree very closely with those of *Melampsora euphorbiae* Cast."

For the information of overseas readers, I should perhaps indicate that, the Australian Plant Disease Recorder is published by the Biology Branch, N.S.W. Department of Agriculture, for private circulation to plant pathologists within Australia.

EILEEN E. FISHER.

Plant Research Laboratory,
Department of Agriculture,
Burnley, Victoria.

PUBLIC SERVICE, TASMANIA.

Applications closing on 13th April, 1955 are invited for BIOCHEMIST, DEPARTMENT OF AGRICULTURE. Salary range £1,334-£1,487 per annum, inclusive of C.O.L. amounts. Duties will include routine diagnostic work and survey work, particularly associated with trace element deficiency, in the first instance. Appointee will be expected to organise the arrangement of a laboratory, and train and direct the work of Junior Technical staff, not yet appointed. Opportunities will be available for research work.

Qualifications:

A University degree in Science, preferably with Honours, and a sound background in the Biological Sciences. Preference given to applicants with Biochemical experience.

Cost of fares of appointee and family, together with cost of carriage of furniture up to three tons in weight, will be refunded on certain conditions being fulfilled.

Appointments will be made in accordance with Provisions of Public Service Act.

Applications are to be forwarded to—Secretary for Agriculture, Box 673-E, G.P.O., Hobart, Tasmania.

A. LINTON,
Secretary,
Public Services Commissioner's Office.

APPOINTMENTS AVAILABLE

THE UNIVERSITY OF ADELAIDE

WAITE AGRICULTURAL RESEARCH INSTITUTE.

Applications are invited for the position of—

CHEMIST

in the Section of Soil Chemistry in the Department of Agricultural Chemistry.

Qualifications: A degree in Science, preferably with Honours in Inorganic and Physical Chemistry. Research experience in soil chemistry will be an added qualification.

Duties: To conduct research into the chemical properties of soils particularly in regard to fertility investigations. The Chemist may also be required to participate in the lecturing programme of the department.

Status and Salary: The appointment carries the status and salary of a Lecturer in the University. Salary range: £A1,100-50-1,450.

Superannuation: On the F.S.S.U. basis.

Travelling Allowance: See detailed conditions of appointment of lecturers.

Applications: An application must include particulars of age, nationality, marital status, academic record, experience, war service (if any) and present position; a list of publications; copies of testimonials; the names and addresses of two referees from whom enquiries may be made; a recent photograph; and a medical certificate of good health. It should be lodged in **duplicate** with the undersigned not later than April 30, 1955.

Further information about the post or about the University and the Waite Institute will be supplied on request.

V. A. EDGELOE,
Registrar.

SOILS OFFICER, DEPARTMENT OF AGRICULTURE, VICTORIA

Applications, addressed to the Secretary to the Public Service Board, Public Offices, Treasury Place, Melbourne, C.2, Victoria, and accompanied by evidence of experience and qualifications and a statement of date and place of birth, are invited for the above-mentioned position up to Wednesday, 20th April, 1955.

Yearly Salary: — £1,406, minimum; £1,506, maximum (including cost of living adjustment).

Duties:—Under general direction, to control soil surveying parties and to investigate soil problems in the field and laboratory.

Qualifications:—To hold a Degree in Science or Agricultural Science, or equivalent qualifications, and to have had considerable experience in soil chemistry and in soil surveying.

In making an appointment to this position, preference will be given in accordance with the Re-establishment and Employment Act 1945.

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ABO

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MANZATE. Manzate is a fungicide based on the chemical Manganese ethylene bisdithiocarbamate. This material has been specially developed for control of fungus diseases in potatoes and tomatoes and in fruit and vegetable crops.

PARZATE. Parzate is a fungicide based on Zinc ethylene bisdithiocarbamate for use against fungus diseases on a wide range of crops, including potatoes.

FERMATE. This is a fungicide based on Ferric dimethyldithiocarbamate. This material is particularly useful for control of tobacco fungus diseases.

METHOXYCHLOR INSECTICIDES. A number of formulations, based on Methoxychlor, are now available. These include Marlate 50, a 50% wettable powder for use on fruit and vegetables, and Marlate 2-MR, an emulsifiable oil, and Dairy Cattle Spray. These last mentioned sprays are for use wherever stock are handled.

C.M.U. WEED KILLER. This material is based on 3-(p-chlorophenyl)-1, 1-dimethylurea. It is a non-poisonous total weed killer, which is effective for long periods. At very low dilution it is ideal for pre-emergence control of weeds in crops as divergent as sugar cane and asparagus.

AMMATE WEED AND BRUSH KILLER. This material is based on Ammonium sulfamate and it is ideal for control of eucalypt suckers and other tree species. It will control Mallee shoots, Crofton weed and most perennial weeds and brush.

Further information is readily available upon request.

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